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Engineering News-Record

Design Features of Indianapolis Activated-Sludge Plant
By Charles H. Hurd

Recent Railway Location in Southern Colombia
By Francis R. Molther

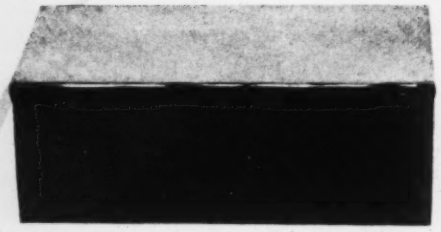
Highway Problems in the Mid-South
IV—Missouri

Concrete Caissons Sunk in Place for Wharf and Seawall
By Frank G. White

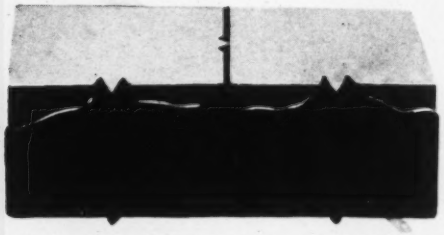
Precast Concrete Caisson for San Francisco Wharf Foundation on Ways in Casting Yard

KREOLITE KOUNTERSUNK - LUG - BLOCKS

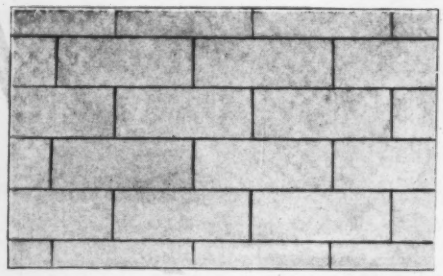
"The Paving that's Saving"



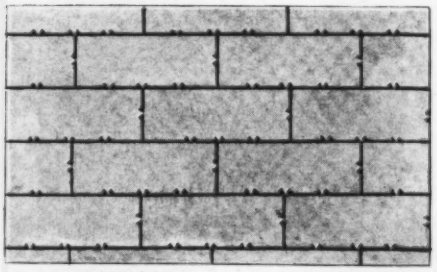
1—Showing imperfect penetration of filler with common rectangular block.



3—Showing nearly perfect penetration of filler with Kreolite Kountersunk Lug Blocks.



2—Plan view of plain or common rectangular blocks.



4—Plan view of Kreolite Kountersunk Lug Blocks.

KREOLITE Kountersunk Lug Wood Blocks are designed for bridge and street paving, and, with a slight variation of the kountersunk feature, for interior factory flooring.

This method of construction permits the penetration of the bituminous filler the entire depth of the block on all sides (see figure 3) securely binding it to the base and making a firm waterproof joint. The filler (our special make) is applied hot in liquid form and hardens when cool. The block cannot become loose because it is firmly attached to the base and to the adjacent blocks on four sides. In laying, only the tough end grain is exposed to wear.

In figure 2, the blocks make a good appearance, but is another case where beauty is only skin deep. The filler solidifies and fills only the upper part of the joint (see figure 1). Note bonding power, so essential to the permanence of any block pavement, as shown in figure 4.

To all City and County Officials, Contractors, Architects, Manufacturers, and others interested, we extend, gratis, the services of our trained engineers.

Write for detailed specifications and information.

The Jennison-Wright Company, 79 Kreolite Bldg., Toledo, Ohio.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Real Wages Rising

STATISTICS too often emphasize the average man—who doesn't exist. A low death rate is no comfort to the man who dies; the average income of all the workers in the country does not provide necessities for the group who fall below it. At the same time, such average statistics are the only means for measuring conditions and they are so used. It is interesting, therefore, to find that the National Industrial Conference Board has found that though the cost of living is still high the American wage earner is better off today than during the peak wage period of 1920. Balancing the cost of living against average wages—using 600,000 specific workers—the board finds that the comparative excess of wages over living costs was 18 per cent greater in May, 1923, than in June, 1920. In other words the workman can get more for his daily labor than he could when wages were highest. Specific demands for higher wages will, of course, have to be answered by specific studies of similar nature but the general fact reported here deserves wide appreciation.

Power Act Interpretation Delayed

AS A RESULT of a conference with the Federal Power Commission the Governor's committee of New York officials have advised Governor Smith not to press New York's suit contesting the constitutionality of the Federal Water Power Act. In so doing the committee sets up for its own demolishment a straw man of federal usurpation when it says that the commission has been prevailed upon to relinquish the federal government's "proprietary right to share in profits" from power on the border rivers. So far as its record goes, the Federal Power Commission has never claimed such rights. Certainly the power act does not confer them; it merely gives the government the right to say who shall use such waters and to see to it that they are not used to the detriment of navigation or to the continuing rights of the people to get reasonable benefits from the flowing water. The federal law hinges on co-operation between state and nation and the people of the state are deprived of no rights under it. There are, however, some questions as to the extent to which the nation may stretch the interstate commerce clause of the constitution to cover power development and these questions can best be settled by Supreme Court ruling. Until New York or some other state chooses to pursue to a finality an attack on the law its full interpretation will not be assured.

For Safety of Contract Records

EVERY so often there comes a report of a fire which either destroys or seriously threatens necessary records. The latest comes from the Borough of Queens, New York City, where last week a midnight fire in a blueprint department came near destroying the records which control about $3,000,000 worth of construction contracts in highway and sewer work in the borough. Such happenings need to be brought to the attention of every one responsible for public work. Not only should duplicate records of every transaction be kept in separate places, but every effort should be made to insure properly fire safe repositories for such records. Building fireproof halls of records after fires have destroyed all previous records comes in the category of locking stable doors after the horse is stolen.

Tarred With the Same Brush

IN THE summer the mills of justice grind slowly; that is the reason little has been heard lately of the government suits and indictments against those who built the cantonments in the early days of the war. In the suits for recovery against the contractors, however, several district court judges have ordered the government to bring a bill of particulars detailing the wastes, which the government charges amounted to from four to seven million dollars at the various camps. Two such bills of particulars recently returned by the Department of Justice are significant, first, because in each the government admits its inability to itemize the wastes which it quite readily totals at seven million dollars and, second, because the detailed wastes, covering several pages of typed manuscript, are identical in the two bills, though one is for a camp in Virginia and the other in South Carolina. This blanketing of a number of different and unrelated men with a common crime is characteristic of the whole procedure of the Department of Justice in the cantonment cases and casts doubt both on the sincerity behind the action and the validity of the cases themselves.

Publicity for Motor Accidents

WHETHER with conscious intent or merely by excellent journalistic instinct a number of metropolitan newspapers have lately taken to grouping each day the increasing grist of automobile accidents. This is one of the best steps toward traffic safety that can be devised. Many motor accidents are unavoidable; they are the inevitable result of our growing traffic congestion. Too many, on the other hand, are due to carelessness, or worse still to an overweening confidence in one's own immunity from accident. Carelessness is an individual and not universal trait, but the assumption that the individual can get away with what spells disaster for others seems to be inherent in the driving of automobiles. Laws and regulations can do little to correct this evil. The best corrective is an accident, but that is somewhat too severe a remedy. The next best thing is continually emphasizing the occurrence of accidents and there are few better ways of doing that than the repetition of grouped accidents in the daily press. Sooner or later this will begin to tell and it will penetrate the consciousness of every automobile driver, provided he or she can read, that crossing occupied rail-

way tracks, passing street cars or other automobiles, speeding around curves and other common but foolhardy driving stunts are more than ordinarily hazardous performances. Perhaps every driver will become as foresighted as that one whose passenger said when they were approaching a railway track that he was afraid the train would beat them to the crossing. " That's all right," said the driver, "What I'm afraid of is a tie."

Snow Removal and Road Damages

SYSTEMATIC study of damages to paved roads from snowfall and removal of snow has not proceeded far. Observation indicates, however, that the effects of snow are more varied and their causes more complex than first assumptions would indicate. There is more for consideration than normal frost action. Frost damages are not novelties to highway engineers but there have come about conditions modifying frost action which are in a measure new. Year-around traffic, heavy loads and snow removal, which formerly did not have to be considered, are now common conditions. Altogether there is before highway engineers a largely new problem of road maintenance as affected by snowfall.

Any conclusions which can at the moment be drawn of the possible damaging effect on paved roads of snowfall and snow removal are necessarily indefinite, if not wholly speculative. Winter damage is evident whether we consider the records of Massachusetts and Connecticut or those of Wisconsin and Minnesota. It is evident too that heavy truck traffic has increased the destruction of road surfaces affected by frost. Again the injuries are different when the road is kept clear of snow and when it is left untouched or is only partially cleared. This is about as far as one can arrive at present. Even this slim array of conclusions, however, indicates a situation which is worth investigation.

Winter freight haulage by motor truck and winter passenger transportation by motor bus must be accepted as certainties. They will moreover extend far beyond thickly populated regions though naturally they will be most intensive where cities and towns abound and industry is intensive. There are today active bus lines in the mining regions of northern Minnesota and Michigan and all through the rural regions of the Middle and Far West as well as in Connecticut and Massachusetts. They are maintaing regular winter schedules. Truck transportation is equally as general, where paved roads exist, though it is customarily less regular.

Where this winter traffic prevails the road will be cleared of snow to provide for its movement. If the clearing is not done by state or county maintenance departments it will be done by the carriers themselves. Indeed carriers generally are doing it. The bus transportation companies today in every state in the North have better organizations for fighting snow and more costly and powerful units of equipment for snow removal, within the fields of their activities, than have most public roads maintenance departments.

Snow removal means different things in different instances. It means completely cleaning the full width of the pavement and also cleaning a path along the center of the paved surface and again only the removal of depth enough to allow traffic to get through. If carriers do the clearing they will, unless they are controlled, carry removal only far enough to serve their purposes. If a single-track path is enough for their purposes this is all they will keep open. If they can maintain schedules with a mat of snow and ice covering the pavement they will not remove this mat. The significance of these facts is, quite certainly, that different damages to road surfaces may be expected according to the practice of snow removal.

If only a single track path in the middle of the road is kept clear, observation indicates that two things happen, (1) Vehicles follow the same tracks and wear is concentrated in ruts and (2) the subgrade under the exposed center zone freezes differently than under the pavement flanks and on the road shoulders which are covered with piles of snow. The second condition is emphasized when there is a heavy fall of snow before the ground is frozen deeply as was the case in some of the New England states last winter. The result is a deep frost crust under the middle of the pavement and shallower frost crusts under the sides and when the frost goes out in the spring the pavement is hung up on a center ridge and under heavy traffic breaks down at the sides and cracks along the crown. If all the snow is not removed down to the pavement, whether it is cleaned full width or not, the covering mat becomes rutted down to the pavement and it is worn in grooves.

These then are some of the indications of the bearing which snow removal may have on damages to paved roads carrying heavy traffic in winter. It is obvious that they are far from exhausting the possibilities. They are, however, enough to demonstrate that a study of road damages from snowfall and removal of snow is a profitable undertaking for highway engineers. Indeed the coming winter, it is hoped, should see it carried well forward. Until the effects of snow removal on damages to paved roads are learned, correct practices of removing snow cannot be established, and they are important if commercial truck and bus lines are to continue their present snow-cleaning operations.

Sewage-Works Progress at Indianapolis

INDIANAPOLIS is contributing materially to the development of sewage-works practice by the 50-m.g.d. plant described elsewhere in this issue. In point of size the plant will be several times the largest in the world when it goes into operation, although soon afterwards it will be surpassed in capacity by the Milwaukee plant and still later by Chicago's large projected plant.

At Indianapolis, Mr. Hurd states, a variety of local conditions favored the activated-sludge process. Some of these made a considerable degree of pre-treatment of the sewage seem desirable before activation. This led to the adoption of the interesting revolving barrel screens, sedimentation tanks, and sludge concentrators which are features of the Indianapolis plant. Sewage-works engineers will await the results of this pre-treatment in order to see whether it may be advantageous elsewhere to lighten the burden on the activated-sludge plant. The working of this type of screens, too, is a matter of wide general interest, for present indications are that fine screening will come into much more extended use than formerly, either where it alone is sufficient for a time or where lessening the load on some more thorough process of treatment is considered advisable. Adherence to compressed air instead of adopting mechanical agitation for activation, although the latter was tested at Indianapolis, is in line with American practice, but it is significant to note that

the filtros plates are set at one side instead of all the way across the bottom of each channel of the aeration tanks, thus giving a spiral motion to the air and sewage.

Dehydration, at Indianapolis and elsewhere, seems to be the subject on which further light is most needed. This need is greater with activated than with other types of sludge, partly because of the peculiar character of this sludge, but largely because the hoped-for end is the production of a commercial fertilizer base, of unusual promise because of the high nitrogen content of the activated sludge. Unlike Milwaukee, Indianapolis will not make use of acid conditioning in its sludge dehydration process—another example of divergence in practice due to local conditions and perhaps somewhat to variations in personal judgment.

Altogether, the Indianapolis plant, both in itself and as a contribution to the development of sewage treatment in general and of the activated sludge process in particular is most commendable.

Engineers for Bridges

FOR an engineer to argue the superiority of the engineer over the architect as a builder of bridges is most difficult. Called upon to do so he feels just as a doctor would who had to defend his profession's right to tend the sick or as would a mathematician when confronted with the statement that two and two make five. It is one of those obvious things that ought never to be questioned. And yet every so often it is questioned and in such a way that engineers in person and in groups are required to restate the obvious. Such an occasion has now arisen in Pittsburgh.

Through a combination of circumstances the county commissioners there are now being importuned to turn over to architects the control of three new and large bridges required by federal order. The circumstances include a doubtless well meaning but misdirected campaign on the part of an eminent Pittsburgh artist to insure, by architectural control, the proper artistic co-ordination of the three bridges with the future development of the city and the efforts of the local chapter of the American Institute of Architects to capitalize this campaign to the advantage of their own profession. In so doing they have repudiated the report of one of their own committees, which collaborating with a local engineering committee recommended a workable scheme for engineering control of the bridges with proper architectural advice, and have gone so far as to submit to the commissioners a list of architects who would be willing to undertake the design and construction of these bridges at a 6 per cent fee. It is possibly only incidental that this list consists not of a selection of architects necessarily qualified for the work, but of those architects who have offered their services for it.

The movement in Pittsburgh to develop the new bridges as commanding elements in the general picture of the city will meet hearty welcome on the part of all engineers. Too frequently in the past the prevailing attitude, forced more generally than not upon the engineer by the public bodies in charge of bridges, has been that whatever would do for the moment's needs at lowest cost was the proper bridge to build. The result was the erection in too many cases of impoverished structures having short life and subject to rapid obsolescence and depreciation. No one knows this better than the engineer. No one realizes better the impoverished art which results from such lowered standards of design. Fortunately, however, the engineering profession is so concerned with safety in structures that in most cases it has been able to resist the low ideal of cheapness and to insist that every bridge shall be the most perfect adaptation of materials to the needs of the type and the service.

Those who are urging the architect's predominance in bridge design, however, seem to consider that safety is something which can be readily obtained by employed experts and that the crowning necessity of a bridge is that it shall be beautiful. The engineer's answer to that is first, that it is essentially vicious that the safety of the public should be made subordinate to the esthetic sense and second, that true beauty results from the proper adaptation of the material to the service and that the engineer who must be responsible for that adaptation can better insure that beauty than can the one whose primary desire is to attain it.

Further than that, the issue is a practical one, for the engineer can point to the many bridge structures which adorn our waterways and cities which achieve true beauty by true adaptation of the material to the service. He is sometimes astonished at the calm assumption frequently made that everything that the engineer builds is inherently ugly and everything that the architect builds is inherently beautiful. So general a rule cannot be demonstrated. The streets of our cities, for whose adornment the architect is solely responsible, are its refutation. One recalls, for instance, the horrible example of the almost interlocking Singer Building and City Investment Building on lower Broadway, New York, built some fifteen years ago by two of the leading architects of their time, built simultaneously, each with the knowledge that the other was being built and yet designed with apparent studied effort for discord between the two in line and tone. Taking the country over it is to be questioned whether the buildings erected by our greatest architects are more beautiful, more adapted to their purpose and to their location, than are the bridges built by our greatest engineers. There are many ugly bridges. There are, on the other hand, many ugly buildings. Appropriateness of a bridge design is a matter of the individual and not of the profession. The question of its safety is distinctly a question of the profession which has it in charge.

It should be farthest from any engineer's efforts to dissociate the competent architect from the design of a bridge. Nor should that association be confined merely to superficial decoration, for in that direction lies the greatest artistic danger. The fact remains that the safety of the bridge should be the prime consideration and for that safety the engineer alone should be responsible, which means that he should have primary control. Having that control he may have to work with him in almost co-ordinate responsibility for outline and general appearance an architect trained in the niceties of adaptation of line and tone. Such collaboration is by no means uncommon, and the resulting structures have been most successful. It can be worked out in Pittsburgh, if the County Commissioners are not stampeded into unwise action by an exaggerated conception of the architect's ability and functions and an insufficient appreciation of the importance of safety in public structures.

Concrete Caissons Sunk in Place for Wharf and Seawall

Seawall for China Basin Terminal on San Francisco Bay Consists of Caissons 57 Ft. Deep Connected by Concrete Arches Placed in Precast Sections

By Frank G. White
Chief Engineer, California Board of State Harbor Commissioners

THE CHINA BASIN terminal, which is under construction on the San Francisco waterfront by the Board of City Harbor Commissioners, consists of a combined transit shed and warehouse located on submerged land about one mile south of the Ferry Building. The terminal building will be 812 ft. long and six stories high, supported on a pile foundation which is protected by a concrete seawall. The seawall consists essentially of a series of precast reinforced-concrete caissons set as piers and between which the openings are closed by curved curtain walls. The caissons, which extend to a depth of 57 ft. below the deck of the wharf,

FIG. 1—LAUNCHING CAISSONS FROM CASTING YARD
Caissons were started down the ways by block and tackle from a hoisting engine. Note temporary concrete bulkhead just inside bottom, which was broken out after caissons were placed.

were cast in a nearby yard, floated to place and sunk to footings prepared under the inspection of a diver. Outside this seawall dredging is to be carried to a depth of 36 ft. below mean lower low tide.

The terminal is located on the northerly side of a small indentation of the shore line known as China Basin, with a hard bottom of cemented sand and clay at a depth of 22 to 40 ft. below mean lower low tide. Overlying this hard bottom is a blanket of soft mud from 12 to 25 ft. in thickness and from borings and soundings it was decided that piles could be driven from 12 to 25 ft. into the sand and clay substrata. In order to add to the stability of the foundation, before any piles were driven, this mud was dredged out and replaced with clean sand. The dredging was done by the commission's own equipment, using a 3½-cu.yd. clamshell bucket dredge and 250-cu.yd. bottom-dump scows.

The caissons, 40 in number, were cast on the side on wooden launching cradles, the casting yard being laid out to accommodate 20 caissons at a time. The cradles were supported on skidways, along which they were moved by hoisting engines to a position in front of the launching ways which were located at one corner of the yard. The caissons were built with three compartments, the outside walls being 7 in. thick and the partitions 6 in. in thickness.

The concrete mix consisted of 1 part of cement to 5 parts of graded aggregate. Concreting was done in two operations; the sides upon which the caissons rested were first poured and after these had set up the inside and outside forms were installed, the remainder of the reinforcing was placed, and the sides, partitions and top were poured. Special care was taken in preparing the contact surfaces and no difficulty was experienced in making watertight joints. The lower ends of the caissons were closed by reinforced-concrete bulkheads in which the reinforcing bars did not project into the side walls or partitions. The upper ends were closed by wooden bulkheads bolted to position from the outside and made tight by asphalt joints.

The concrete in the caissons was allowed to set for at least 28 days before they were launched. After launching they were towed to the site and set in holes excavated to depths of 6 to 18 ft. in the hardpan. In excavating these holes the contractor used cartridges made up of sections of old boiler tubing, 3 to 5 ft. in length. After being loaded each cartridge was wedged into a hole in the bottom of a heavy steel spud

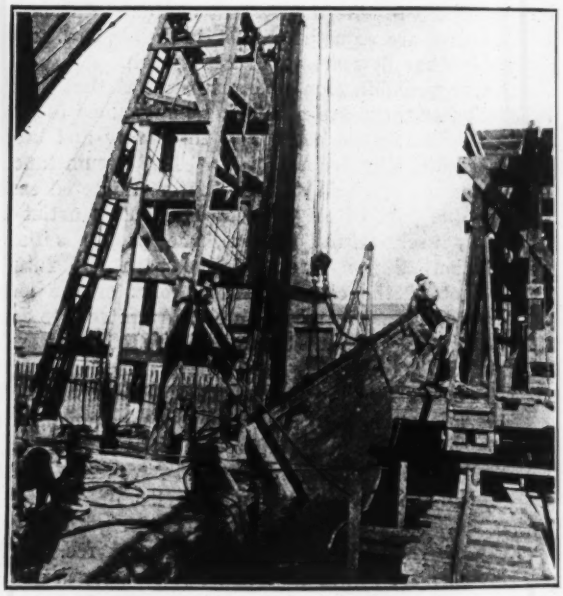


FIG. 2—FILLING AND SINKING CAISSON TO POSITION
At stage shown, the weight of the caisson, partly filled with water, is carried by the pile driver. Later the weight was transferred to four chain blocks on the traveler at the right.

which was dropped through the water driving the charge into the hard bottom. After being shot the material was removed by an orange peel bucket operated from a floating derrick. This method of loosening the bottom proved to be an inexpensive means of doing what would otherwise have been costly. The contractor was expressly forbidden, by the specifications, to follow the cheaper method of dredging a channel for the row of caissons because it was desired to gain the advantage

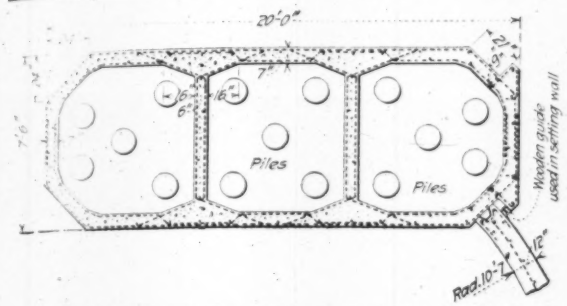


FIG. 3—PLAN OF THREE-COMPARTMENT CAISSON

of the side support that could be expected from putting the caissons in holes. The excavation was carried approximately 12 in. below grade, the holes being gaged by lowering a templet made of steel angles. A diver inspected each hole as the templet was lowered, trimmed off any irregularities or high spots, and supervised the placing of the crushed rock which was used to level up the bottom and bring it to grade.

The setting of the caissons was done by the combined use of a floating pile driver and a traveler mounted on pile falsework. The traveler was of timber supported on 18 double-flanged wheels running on three rails, the gage of the outside rails being 15 ft. This traveler was also used for placing the crushed rock in the bottoms of the holes, hoppers being constructed on top of the frame from which the rock was distributed through a jointed pipe. The caisson to be set was towed to position with the lower end toward the hole in which it was to be placed.

By pumping water into one side compartment and taking a lift with the pile driver on U-bolts set in the top in line with the opposite partition, the caisson was turned on edge. The lower end was then placed between bents of the falsework and the filling and hoisting continued until it was suspended in a vertical position. The load was then transferred to four chain blocks on the traveler by means of which the setting with the faces truly vertical and to line could be very closely controlled. When set in final position the caissons were

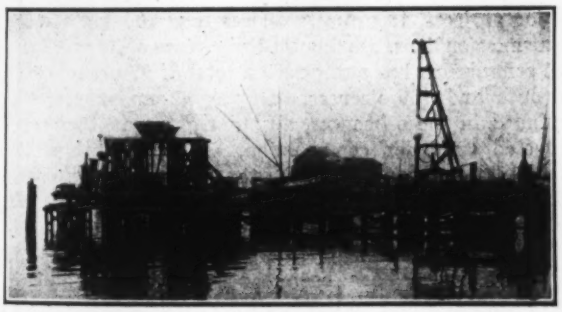


FIG. 5—TRAVELER SETTING CAISSONS IN FINAL POSITION
Traveler on falsework at the left carried crushed rock hoppers and also chain blocks for placing caissons. At right steam hammer is driving piles through bottoms of caisson already set.

14.5 ft. apart with the 20-ft. sides at right angles to the axis of the wall. The average weight of the caissons was approximately 150 tons, but the displacement was so accurately controlled by water ballast that they were readily placed by four 5-ton chain blocks.

The spaces between the caissons and the sides of the holes in which they were set were filled with crushed rock thoroughly tamped into place, using a heavy steel tamping bar handled by a floating derrick. Water was then admitted to the caisson. If any unequal settlement occurred jacks on timbers laid temporarily across adjacent bents lifted the lower side of the caisson by raising timbers carrying chains to the caisson U-bolts. With the jacks thus holding the caissons plumb, crushed rock was dumped and tamped around the lower side until the caisson stood plumb without the aid of jacks. When firmly bedded in final position the lower bulkheads were broken out and the concrete was thoroughly pulverized by the use of the steel chisel and tamping bar already referred to. By means of a follower a pile driver mounted on the falsework then drove fifteen piles in the bottom of each compartment, securing in all cases a penetration of 12 to 20 ft.

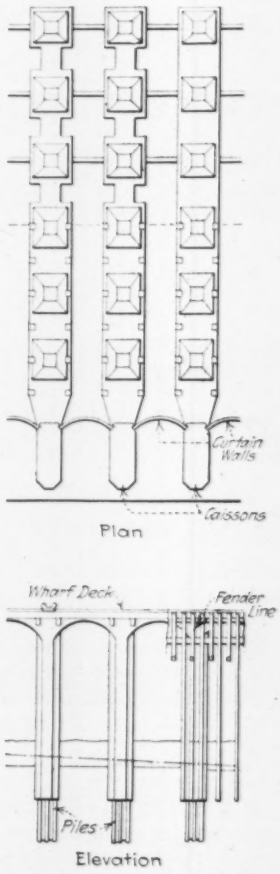


FIG. 4—PLAN AND ELEVATION OF FOUNDATION AND SEAWALL

The caissons were sealed by depositing about 10 ft. of tremie concrete around and over the heads of the fifteen piles, which were left projecting approximately 8 ft. into the bottom. The tremie rig was equipped with a tower and hoisting engine for handling the 18-in. pipe and with three concrete hoppers, each of sufficient capacity to permit of filling a compartment to the required depth with one charge. After this concrete had set, the caissons were unwatered, the laitance and separated materials, having a thickness of 1 to 2 ft., were removed and the pouring of concrete used to fill the caissons was completed. The concrete used in the tremie work was 1:4 and in the remainder of the caisson fill, 1:9, the aggregate being proportional in both cases for maximum density.

The reinforced-concrete curtain walls closing the spaces between the caissons are arches 1 ft. in thickness. The curve is an arc of a circle and each section comprises a quadrant, i.e., has a central angle of 90 deg. Three sections of these curtain walls were used to complete the required height of 34 to 40 ft. The curtain walls were cast in a vertical position on barges, the forms being set for complete circles with partitions at the quarter points to separate the four quadrants. They were cast with tongue-and-groove horizontal joints. The arches were set with the aid of a floating pile driver, wooden guides being used to hold the curtain wall tight against the bearing surface of the caisson.

After the three sections required to make a complete

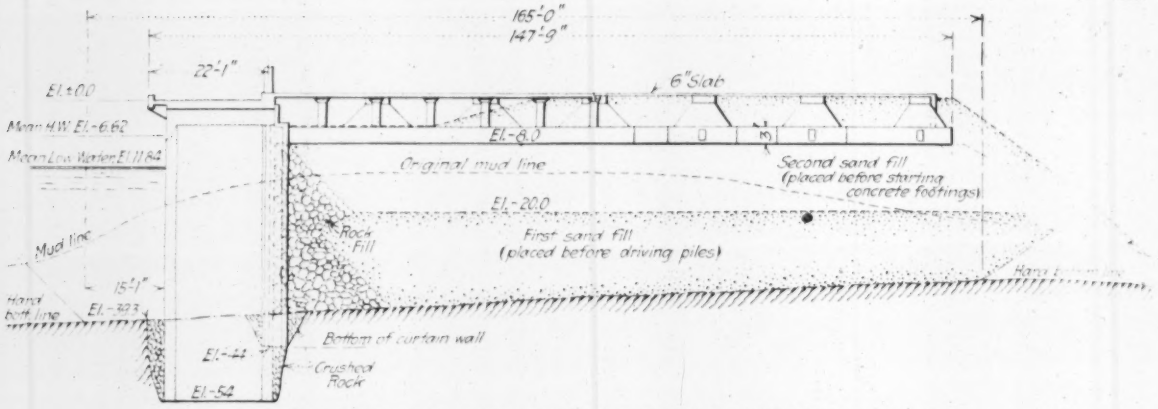


FIG. 7—TYPICAL SECTION THROUGH SEAWALL AND FOUNDATION

closure between adjacent caissons were in position, the vertical groove on either side of the curtain wall was filled with grout. To prevent the grout from escaping through the cracks along this groove, it was deposited inside a canvas bag or "stocking." When the sections of the curtain wall were all placed, a 2-in. iron pipe was lowered down the groove to make sure it was clear. The pipe was then withdrawn, the canvas "stocking" was slipped over it, and pipe and "stocking" were lowered into the groove. The upper end of the pipe was connected with a hopper containing grout, hopper and pipe being slung from hoisting tackle on the pile driver leads. When pipe and stocking had been lowered to

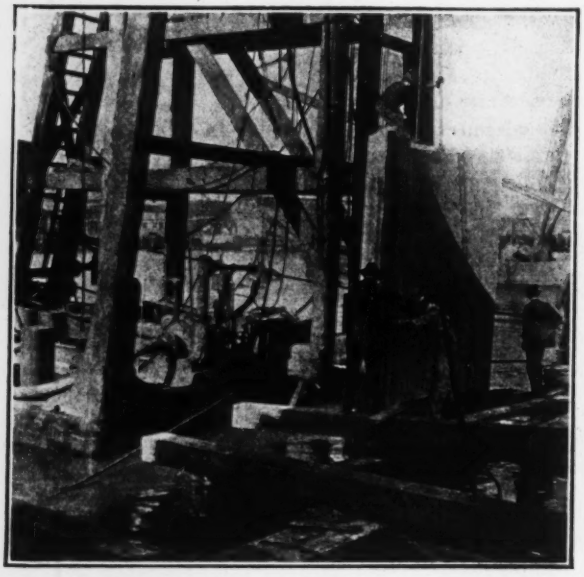


FIG. 6—LOWERING TO PLACE SECTION OF CURVED CURTAIN WALL

These sections 12 ft. long and weighing about 16 tons were delivered on barges and placed with tackle from the driver leads.

the bottom of the groove, grout was admitted to the pipe and as the stocking filled, the pipe and hopper were lifted. This proved to be a very effective means of making a tight joint between curtain and caisson. After the curtain walls were grouted a rock fill was placed against the inside face and between the caissons on the outside of the curtain wall.

The building foundation consists of concrete footing supported on clusters of piles which were driven through the sand fill and into the underlying hardpan. Combined with these footings are a series of heavy reinforced-concrete ties, 3 ft. deep and 8 ft. wide, which serve to anchor the tops of the caissons to the heads of the piles across the full width of the building. Steel tie rods were used, hooked into notches provided in the second lift of the caisson fill, and the last lift of the caisson fill was poured with the footing.

The first floor over the outer half of the building is of flat slab construction and is supported by the column footing; the remainder or inner portion of the floor is laid directly on the sand fill. The floor or deck of the wharf along the channel consists of a series of arches extending from caisson to caisson and designed to carry two railroad tracks.

Past Year Shows Increase in Federal Water-Power Permits

The Federal Power Commission closed its fiscal year on June 30 with a total of 425 applications for preliminary permits and power development licenses. One hundred and four of these were received during the past year, 51 of which were applications for preliminary permits for investigatory purposes. The remaining 53 were for licenses covering construction, and included 17 major projects, 13 projects of less than 100 hp., and 23 transmission lines. During the three years of its existence the commission has authorized a total of 97 preliminary permits and 105 licenses. Of the 42 major projects included in these licenses, all but eight are either constructed or under construction, and all but three or four will go ahead within the time limit of the license. With respect to the preliminary permits, however, the progress has not been so marked. Only five of the 97 issued have been followed up with applications for licenses, twelve have been cancelled, and the others have been extended to the full time limit of three years. This time limit will expire on several important projects next March. Among them is the White River project of the Dixie Power Co. in Arkansas, the 350,000-hp. development of the Washington Irrigation & Development Co. at Priest Rapids on the Colorado River, and the proposed Niagara Gorge development of the Lower Niagara River Power & Water Supply Co., a subsidiary of the Niagara, Lockport & Ontario Co. This latter development is being held up at present by the failure of the State of New York to grant the company the necessary permit.

Variations in Floor Load Requirements of Building Laws

IN THE STUDY of building law requirements now in progress by a committee of the U. S. Department of Commerce, the wide variation in ordinance requirements as to the loads for which floors must be designed has had special attention. The committee has also endeavored to collect such scanty data as exist concerning actual loads which occur or may be expected in different classes of occupancy, and in this connection brought about the conduct of a special set of load weighings in the Equitable Building as reported in *Engineering News-Record* of March 29, p. 584. Its work requires much further collection of data on actual loads, however, and the committee is anxious to enlist the co-operation of technical organizations and individuals throughout the country in obtaining such data. To exhibit the unsatisfactory present conditions the committee has compiled a table of the floor loads specified for building design by 109 city building laws. A summary of the table is reproduced herewith.

MINIMUM FLOOR LOAD REQUIREMENTS IN 109 CITY BUILDING LAWS

Occupancy	Number	Aver. Load	Minimum Load in Pounds per Square Foot																																				
			20	25	30	35	40	50	60	62.5	65	70	75	80	85	90	100	105	108	110	112.5	115	120	125	130	140	145	150	160	175	180	200	250	300	350	500
Dwellings: 1st floor	107	52.2		1	2		28	31	38			3	1	2			1																						
above	103	49.7		1	2		40	28	26			3		2			1																						
Tenements: 1st floor	10	55.8			1	1	21	32	37			4	2	8		1	2																						
above	105	50.6			1	1	37	33	25			4	1	2			1																						
Stores: light, 1st floor	107	119.4												1			26						41	29				9			1							
light, above	102	115.0						1					1	1		1	34						39	18				6			1							
heavy, 1st floor	98	162.8															12						12	6	1			31			21	11	1				
heavy, above	94	136.9														1	13						11	7				29		2	1	18	9	1				
Warehouses: heavy	98	184.2															8						4	1				28				39	16	1	1			
light	100	137.7															22						28	14				16		2		12	3	1				
Factories: heavy	97	177.0															10						6	5	1			28		1		23	20	1				
light	10	121.8															27						37	25	1			10				2	1					
Roofs: less than 20 deg.	10	39.2		6	26	1	740	27																														
more than 20 deg.	88	31.0	7	9	56		12	4																														
Assembly: moveable seats	102	110.3										1		1		14	38						22	20				6										
Halls: fixed seats	102	95.9						1	1			2	8	15		33	22						3	14				3										
drill halls	93	137.0										1				4	17		1	1			17	13				27	1	1		3	7					
dance halls	94	115.9										1				4	18		1	1			26	14				25		1		2	1					
Schools: corridors	96	92.5						1	3			7	13	11		26	18						7	7				3										
assemblies	101	99.5							1			2	12	7		26	23	3			1	7	15				4										
class rooms	96	69.9					3	10	21	1		9	41	3		5	1						1					1										
Office buildings: first floor	101	114.0					1	3	1			3		8		2	30						12	14				27			1							
above	106	69.7					4	14	22			6	49	3		2	4											2										
Public buildings	80	105.8					1					1	3	1		9	37				2		6	14				5										
Garages: public	90	126.6						1					2	5	1		24						8	11		1		30		2		3	1					
private	80	73.9			1		3	4	5		2		24	7	1		18						8	3				1				2						
Hotels: rooms	104	57.3			1	1	15	30	40		1	4	7	1		1	2											1										
corridors	88	87.7					5	3	8			5	7	13		17	14						6	7				3										
Hospitals: wards	96	61.0			1		13	24	35			4	7	4		1	4						1	1				1										
corridors	84	83.6			1		5	4	10			2	4	16		20	11						5	5				1										
Side walks	63	272.0																										4			9	9	40		1			

The committee believes that such variations correspond to no essential differences of practice or of conditions in different parts of the country, and that they largely arise from actual ignorance of the loadings to be expected. The collection of loading data should, therefore, prove a preliminary toward the elimination of unnecessary and wasteful diversity of practice.

Gassing of Enginemen in Railway Tunnels

ACCIDENTS to locomotive crews in tunnels on the Union Pacific R.R., due to pollution of the air by gases from the engines, has led to an investigation by the U. S. Bureau of Mines. A report by S. P. Kinney, assistant metallurgical chemist of the bureau, states that in thirty-four out of forty trips through the tunnels carbon monoxide was found in the air: twenty-nine tests showed 0.01 to 0.20 per cent and five showed 0.21 to 0.35 per cent. In a normal running time of six minutes for 2,000-ton trains through the Aspen tunnel, 5,941 ft. long, the cab temperatures reach 114 and 111 deg. F. on the dry and wet bulb thermometers respectively, with a relative humidity of 90 per cent. The maximum temperatures recorded were 136 and 124 deg. respectively. Actual running time was ranged 4½ to 25 min.

It was found that asphyxiation due to carbon monoxide and exhaustion due to high temperature and humidity are the main causes of the accidents in these tunnels. Pocket respirators and other types of gas masks packed with soda-lime-charcoal mixtures afforded protection against smoke and sulphurous gases, and carbon-monoxide masks against all gases encountered, though there was some discomfort in wearing gas masks in an atmosphere of high temperature and humidity.

Air from the train pipe of the brake system showed no carbon monoxide and is cooler than the cab air. It is recommended that the engines carry respirators which can be attached to the train pipe, giving a supply of air sufficient for ten minutes, or thirty minutes in combination with the air-brake tanks. Deflectors on the smokestacks, which deflect the smoke and gases away from the cab, are reported to be efficient in reducing cab temperatures 20 to 30 deg. As carbon-monoxide poisoning requires special treatment, it is suggested that engine crews, signal repair men and men working in the vicinity of the tunnels should be instructed in first-aid treatment for such cases. It would be advisable to shorten the time of passage through long tunnels.

Highway Progress and Problems in the Mid-South—IV

South Carolina North Carolina
Virginia West Virginia
Kentucky Tennessee
Missouri

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars—Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

This is the closing article of the series. The other articles which have appeared, in "Engineering News-Record," are: Group Problems and the two Carolinas, July 26, p. 128; the two Virginias, Aug. 2, p. 168; and Kentucky and Tennessee, Aug. 9, p. 228.

Missouri

Speeding Construction

Missouri has under way one of the largest road building programs of any state in the Union. In developing its work it has laid down the principle that highway improvement is a process. Progressive construction and full-system maintenance, as practiced in other states, are included in highway improvement as a process, but in Missouri the thought is carried farther to a definite plan of popular education. "Highway development is a process" has been made virtually the official slogan of the state highway administration.

Missouri's present large road building program first assumed definite shape in 1921 when the state legislature in a special session designated the 7,630-mile state road system, and the people by popular vote authorized the sale of $60,000,000 worth of bonds for the purpose of financing the construction of these state roads.

It is a construction and maintenance task being rapidly accomplished that we have to consider at present. On April 1, 1921, there had been completed 141 miles of the roads comprising the state system, of which 7 miles were of graded earth. Stating this result in terms of the entire system there were then 1.75 per cent of the system surfaced and .094 per cent of the remaining portion of the system graded preparatory to surfacing. On April 1, 1923, there had been completed 1,448 miles of state roads, of which 775 miles were of graded earth. Again expressing these results as percentages of the whole, there are at this time 8.885 per cent of the system hard surfaced and 11 per cent of the remainder graded preparatory to surfacing.

On April 1, 1921, the rate of progress was 1.2 miles of graded earth per annum and 72 miles of surfacing per annum. On April 1, 1922, the rate for graded earth had increased to 248 miles per annum and the rate for surfacing had dropped to 60 miles per annum. On April 1, 1923, the rate of progress had reached the figure of 702 miles of graded earth per annum and 94 miles of surfaced highways per annum. Production of graded earth roads increased faster than surfaced roads.

There are at this time 429 separate road projects under way, totaling nearly $29,000,000 worth of work under contract, calling for the grading of 987 miles of earth road and for the surfacing of 1,006 miles of paved highways. The funds available for further lettings in 1923 consist of $1,632,000 of federal-aid and $4,900,000 of bond issue money. There are now 261 miles of primary roads under contract at a price of $6,306,650, averaging $24,200 per mile. There are also under contract 413 miles of secondary roads to be built out of bond issue money, aggregating a total cost of $4,199,110 or about $10,150 per mile. Bond issue projects are under way all over the state with the exception of 23 counties. There have already been established in 86 counties county-maintenance organizations headed by a county-maintenance superintendent who reports to the division maintenance engineer. Contracts are being made for maintenance work with local parties, special road districts and county courts to cover principally the dragging of roads at a price of $40 to $50 per mile per annum. The county maintenance superintendent is furnished with a Ford roadster or a Ford truck and is supplied with picks, shovels and other small tools which are on hand as part of the War Department equipment allotted to the state. Also one or two tractors are being distributed to each county for use in the maintenance of its state roads, such tractors being a part of the above mentioned War Department equipment. A further impetus to maintenance operations will be given by the new equipment for which orders have been placed. This equipment includes 106 graders of varying sizes and weights, 239 drags, 123 road plows and 219 scrapers.

Out of the necessities of the work there has grown up the organization indicated on the adjoining chart, Fig. 7. In order to relieve the executive head of the large burden of routine operations, much of the detail of the administrative work of the department has been subdivided and alloted to the following bureaus: (1) Bureau of Surveys and Plans; (2) Bureau of Bridges; (3) Bureau of Construction; (4) Bureau of Maintenance and (5) Bureau of Audits.

Each bureau is in the charge of a bureau head, who is in close contact with the chief engineer. Weekly reports by each bureau chief are made to the chief engineer. These reports are bound together and supplemented by a report of the chief engineer and then transmittd to the commission. In this manner each member of the commission is regularly informed of the operations of the department during the period between meetings of the commission.

Speed in getting a large construction program under way as described, in establishing maintenance and in creating a direction organization is the salient characteristic of the moment of road development in Missouri. With maintenance proceeding, road grade is being produced first and then surfaced road. Two types of paved road present unusual practice; one is bituminous surface on sledged stone base and one is base of 1:3:5 concrete used as a road until traffic warrants addition of the bituminous surfacing. An outstanding structural feature of Missouri road work is

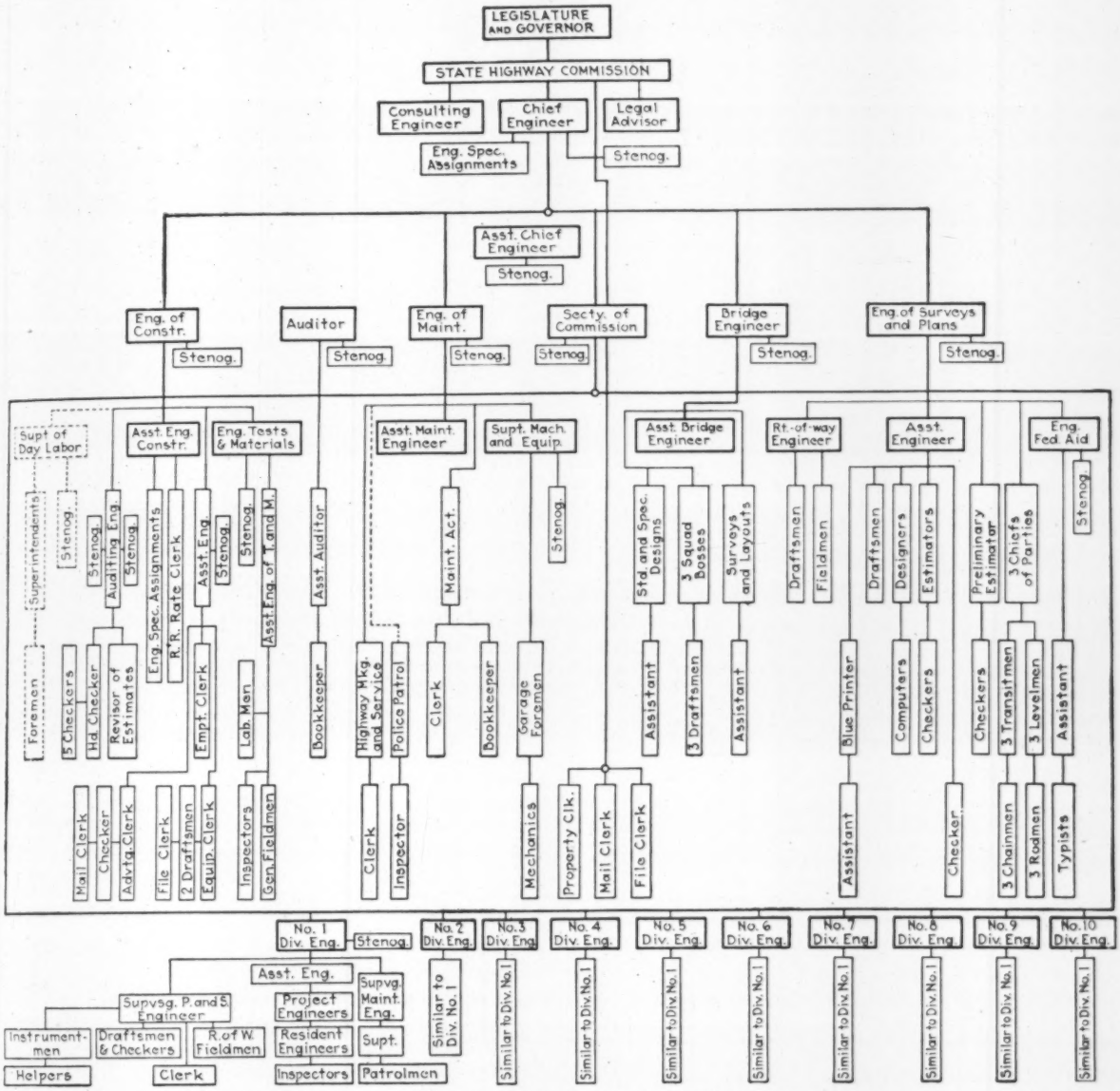


FIG. 7—MISSOURI HIGHWAY COMMISSION ORGANIZATION CHART

bridge building. Missouri is a state of many streams and notably of one great stream, the Missouri River, dividing the state into two parts. Present highway work includes no less than four Missouri River bridges, with steel structures, respectively 2,665 ft., 1,524 ft., 1,955 ft., and 3,071 ft. long, to cost $2,847,212.

Recognition of the fact that successful highway administration is in part the task of holding the faith of the people in highway improvement is the vital spark of Missouri highway department practice. There is no state of the group, that has been considered in this series of articles, in which the people are being so candidly and continuously told what is being done and why, what the fundamental processes of highway development are, what excessive speed and overloading signify and what the part of the public is in managing its great highway property. "Tell the people" is almost the cardinal commandment of the road administration decalogue.

Vermont Reorganizes Its Government

The administrative departments of the State of Vermont have been consolidated so as to replace over twenty boards, commissions, officers and agencies by seven departments. Of these the departments of highways, public service, public health, and education are placed under small boards, while the finance, public welfare, and agricultural departments have a single head. The Department of Public Service includes utility regulation, weights and measures, regulation of labor disputes, and the general regulation of the industries of the state. The Department of Finance has charge of budget making, banking and insurance, taxation, accounting and purchasing. All the department heads and commission members are appointed by the governor. The tenure of office for the single commissioners is the same as that of the governor, but the terms of members of the boards, in the four departments named, expired at different times.

Design Features of the Indianapolis Activated-Sludge Plant

Circulating Aeration Effected by Deflecting Baffles Giving 6-Mile Travel at Rate of 2 Ft. per Second—Rapid Removal of Sludge in Deep Tanks with Settling Cones Near Inlets

By Charles H. Hurd
Consulting Engineer, Sanitary District of Indianapolis, Ind.

SEWAGE treatment at Indianapolis will be a combined system of partial clarification by fine screens and rapid settling followed by an activated-sludge process. The primary treatment portion of the plant was described in *Engineering News-Record*, March 23, 1922, p. 484. This article deals with the activated-sludge plant and the bearing which the experiments at the testing station of the last year have had on the design. In general it has been found that the rapid and early removal of suspended organic solids is a large factor in the aeration process and that a circulating aeration induced and

CONCENTRATE THICKENER TANKS FOR CONTINUOUS SLUDGE REMOVAL

The sludge removal mechanism consists of chain-driven flights which scrape the sludge toward concentration cones at the inlet ends. The framework to support the upper returning flights will be placed near the top of sloping sides in the recesses shown.

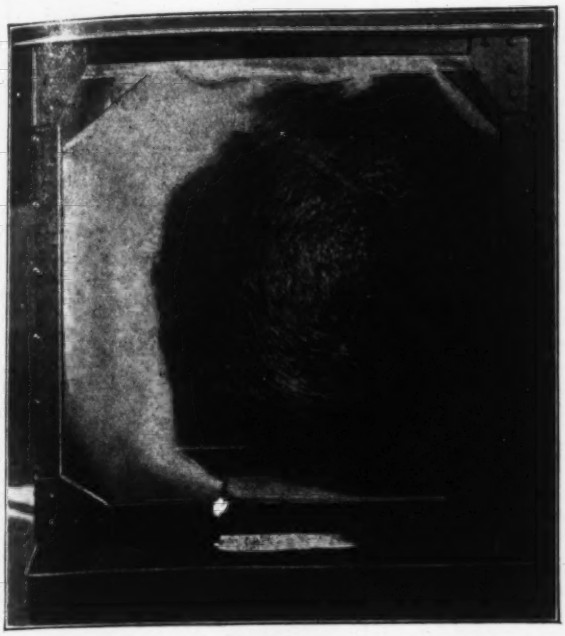
speeded up by proper baffling gives better results and at greatly reduced cost than the conventional types of air plate distribution. Deep sludge settling tanks with the cones placed close to the inlets are preferred. Present methods of sludge dehydration procedure leave so much to be desired that final designs and choice of apparatus will be fully developed under actual working conditions.

From sewer gagings it has been estimated that the average dry-weather flow for the Sanitary District of Indianapolis will be 50 m.g.d. for 1930, 64 in 1940 and 72 m.g.d. in 1950, with maximum day flows at rates of 75, 96 and 108 m.g.d. respectively. In the plant design, all structures which are placed below ground and which cannot be easily extended or expanded are constructed for the calculated 1950 condition; all structures which may be more readily extended or expanded, and in which there would not be considerable economic loss due to expansion, are built for the assumed capacities for the 1930 condition.

Rapid Sedimentation Tanks—As was described in the article mentioned, the concentrate thickener tanks perform a most important function. Briefly, these tanks are four in number, 15 ft. wide, 120 ft. long and 12 ft. deep. They are constructed with sloping sides at the bottom and provided with sludge removal mechanism and concentration cones at the inlet end. In operation, the heavy sewage containing the suspended solids, which have been retained by the fine screen filters, flows by gravity directly to the inlet of the tanks. In this operation it is important not to break up the individual masses or to separate the adhered colloids from the solids in suspension. The four tanks have a volumetric capacity of 500,000 gal. and when operating at a rate equal to 30 per cent of the total flow to the screens (equivalent to 15 m.g.d. for the 1930 conditions) will have a subsidence period of 48 minutes. The velocity of flow through the tanks corresponding to this rate is 2.5 ft. per minute. The sludge removal flights operate at a velocity of from 5 to 7.5 ft. per minute. The returning flights which pass through the sewage about 3 ft. from the bottom, move in the same direction as the sewage flow. In the preliminary design, it was considered advisable to operate the flights at the same velocity as the flow of sewage. Subsequent tests, however, have proved this to be unnecessary. The high efficiency of these tanks is undoubtedly due to the freshness of the sewage treated and the means of conducting the sewage through the screen channels and connecting conduits without agitation. The high rate can be accounted for by the absolute control and the uniform and continuous flow from one end of the tank to the other. This complete displacement prevents counter or conventional currents resulting from short circuiting or changes of temperature. Two 3-hp. motors are provided for operating the four tanks.

Activated-Sludge Development—Experience has shown that in the activated-sludge process the rate of treatment depends largely on the freshness of the sewage and the total organic solids contained. With Indianapolis sewage the aeration rate is governed largely by the removal of organic solids in the thickener tanks. During the year 1922 experiments were continued at the demonstration plant to determine the most economical operating rate as well as the quantity of air necessary to produce the required stability. Five aeration tanks were used for this purpose, all of which were 15 ft. deep. Four of these tanks were circular in plan and 12 ft. in diameter. The fifth tank was originally constructed as a section of a proposed full size unit and was 15x15 ft. in elevation and 5 ft. long.

Subsequent to tests that were made on screened and unscreened sewage and a demonstration of mechanical agitation, Tank 1 was continued as a control unit with the conventional arrangement of diffuser plates and with a total plate area 25 per cent of the tank area. Tanks 2, 3 and 4 were equipped with different systems of vertical baffling and diffuser plates, with 10 to 12 per cent diffuser area, set eccentrically in the bottom to give over-and-over circulation in the tanks. Tank 5, designated at the plant as the "circulating tank," contained six diffuser plates independently controlled and set in two rows within 30 in. of one side. Five plates were in operation during the greater part of the demonstration runs, which gave a 6.66 per cent diffuser area. Throughout these tests on the tanks above described the average rate of operation per acre was 25 m.g.d. and the use of air varied from 0.5 to 1.25 cu.ft. per gallon of sewage. The composite results of these tests



TRANSLATION OF AIR BUBBLES IN GLASS CIRCULATING TANK

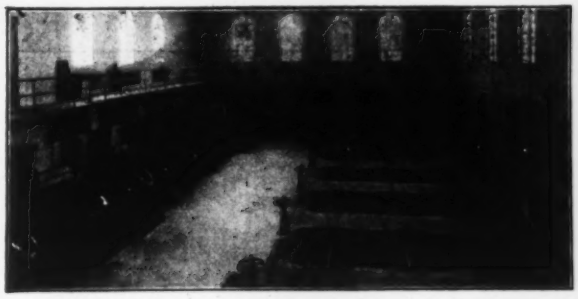
Water velocity at 2 ft. per second sweeps across bottom of tank and deflects incoming air rising from air plate to the left. Baffles at corners give the rotary motion which in a large tank (of which this is a miniature transverse cross-section) would be a spiral, with the pitch determined by the detention period and the length.

indicated that a stable effluent could be obtained at the above rate of operation with an approximate use of 1 cu.ft. of air per gallon of sewage treated.

As a summary of the experimental work on aeration at the demonstration plant during the past two years and a comparison of the types of tanks used it may be stated that the most satisfactory operation was obtained by the use of the rapid circulating tank. This tank was operated in parallel with the conventional types and followed experiments on mechanical agitation. The conventional tank produced a stable effluent, but required a slightly greater quantity of air than the circulating tank to keep the sludge in suspension. The mechanically agitated tank was not consistent and dependable in operation and did not produce a good quality of sludge nor a satisfactory effluent.

Tests on Circulation — Following the comparative study of the three types or methods of aeration, extended experiments were made to determine the best and most economic system of deflecting baffles for the circulating tank. The greater number of these experiments were made with air supplied at the rate of 0.5 cu.ft. of air per gallon of sewage and the operating rate at 20 m.g. per acre. Generally speaking, the use of deflecting baffles increased in the circulating velocity almost proportionally to the area up to about one-fourth the distance across the tank. The angle and total deflector area which seemed most economical in construction and service is shown in the sectional elevation of the aeration plant. It should be noted that this method of baffling increased the circulating velocity practically 100 per cent above the velocity produced without baffles.

The preliminary design of the aeration plant provided for units with circulating channels 15 ft. wide and 15 ft. deep. While the plans were being developed more extended experiments were made by increasing the width of the circulating tank section to 20, 25 and 30 ft. The purpose of these experiments was to determine the greatest width which would be practicable (maintaining sufficient bottom velocities to prevent deposition of sludge), in order to reduce the construction costs. As shown in Table I, all of these various widths of section apparently gave sufficient bottom velocities. The 20-ft. section was adopted as most advantageous for construction.



FINE SCREEN CLARIFIERS IN PUMPING STATION

Rotary screens are revolved by vertical motor at left through a jack shaft to which any one screen of three in a set can be connected by clutch.

Aeration Tank Design—Consistent with rates established in experimental operation the present aeration plant is being constructed with an area of 2.5 acres and for an average capacity of 50 m.g.d., equivalent to 20 m.g.d. per acre. The diffuser area is 7.5 per cent of the tank area, but provision is made to increase this area to 10 per cent or more if found desirable or necessary. The plant is divided into seven units, five of which are full size and two half size. The first half tank is placed in a position and connected so that it may be used for re-aerating or re-tempering sludge. All tanks are 238 ft. long, 15 ft. deep and have a channel width of 20 ft. The full size units have four complete passes, which give a total longitudinal travel of the sewage of about 950 ft. With the baffling shown and the use of 1 cu.ft. of air per gallon, the surface

TABLE I—MEASUREMENT OF VELOCITIES IN CIRCULATING AERATION TANKS

Air per Gallon, Cu.Ft.	Ft. from Bottom	15-Ft. Tank: Distance from Filtros End-Ft. 5	7.5	10	15	Air per Gallon, Cu.Ft.	Ft. from Bottom	30-Ft. Tank: Distance from Filtros End-Ft. 5	10	15	20	25
0.90 c.f.	7.5	....	....	0.38	....	0.90	7.5	0.31	0.48	0.73	0.52	0.61
	5.0	0.21	0.19	0.43	....		5.0	0.31	0.48	1.03	0.49	0.42
	2.5	0.40	0.46	0.58	....		2.5	0.28	0.38	0.85	0.88	0.90
	0.5	1.42	1.91	1.85	....		0.5	0.96	1.56	1.53	1.80	1.88
0.75	7.5	....	....	0.38	....	0.75	7.5	0.37	0.40	0.31	0.33	0.48
	5.0	0.21	0.37	0.47	....		5.0	0.31	0.35	0.31	0.50	0.88
	2.5	0.49	0.55	0.64	....		2.5	0.49	0.35	0.64	1.09	1.03
	0.5	1.58	1.84	1.64	....		0.5	0.89	1.30	1.72	1.79	1.59
0.50	7.5	....	....	0.47	....	0.50	7.5	....	....	....	....	....
	5.0	0.29	0.24	0.76	....		5.0	....	0.53	0.29	0.44	0.53
	2.5	0.47	0.53	0.85	....		2.5	0.34	0.45	0.33	0.67	0.83
	0.5	1.55	1.64	1.64	....		0.5	0.72	1.22	1.34	1.53	1.53
		20-Ft. Tank						25-Ft. Tank				
0.90	7.5	0.49	....	0.29	0.49	0.90	7.5	....	....	....	1.05	....
	5.0	0.49	....	0.44	0.37		5.0	0.23	0.47	0.85	0.72	....
	2.5	0.44	....	1.07	0.94		2.5	0.37	0.61	1.57	1.03	....
	0.5	1.25	....	1.79	1.89		0.5	1.01	1.79	2.17	1.85	....
0.75	7.5	0.44	....	....	....	0.75	7.5	....	....	....	0.80	....
	5.0	0.44	....	0.34	0.46		5.0	0.31	0.31	0.53	0.94	....
	2.5	0.70	....	1.09	0.73		2.5	0.21	0.31	0.91	0.97	....
	0.5	1.42	....	1.94	1.78		0.5	1.13	1.46	1.82	1.73	....
0.50	7.5	....	....	....	....	0.50	7.5	....	....	....	0.79	....
	5.0	....	....	0.39	0.35		5.0	0.28	0.28	0.35	0.91	....
	2.5	0.67	....	0.91	0.76		2.5	0.31	0.37	0.85	0.85	....
	0.5	1.43	....	1.64	1.55		0.5	1.08	1.21	1.54	1.48	....

and bottom velocity of the tank will approximate 2 ft. per second and when operating at the rate of 20 m.g.d. per acre this will be equivalent to a spiral travel of more than six miles within the length of the tank.

The principal saving in construction of the type of aerator adopted over the usual type (with diffusers distributed over the entire bottom) is the lesser number of diffuser plates required and the elimination of a very expensive diffuser and floor system. The advantage of air circulation over such mechanical agitation as we have knowledge of is that with equal opportunity for economy due to the surface adsorption of oxygen there is an assurance of always having a sufficient quantity of entrained air to give positive oxidization throughout the sewage mass.

Construction Details—The diffuser plates in the aeration tanks are set in and above recesses cast in the floor and are inter-connected by 4-in. vitrified-glazed pipes imbedded in concrete in the 12-in. space between the individual plates. Fifty plates are operated from each air-control valve. The air is introduced in the middle of each section and by means of continuous circulation prevents the accumulation of water underneath any

TABLE II—OPERATING RESULTS OF EXPERIMENTAL ACTIVATED-SLUDGE PLANT

1922 Week Ending	Cu.Ft. Air per Gal.	Sludge Returned Per Cent	M.G. per Acre per Day	Oxygen: Consumed	Oxygen: Dissolved	Oxygen: Demand	Suspended Solids
Aeration Unit 1—Conventional Type with 25 Per Cent Diffuser Area							
1-14	0.93	23	25.8	32	2.4	4.	28
1-21	1.03	27	23.1	29	2.1	3.1	20
1-28	1.37	25	22.9	23	3.	4.	21
2-4	1.17	30	21.8	15	3.2	4.3	24
2-11	1.30	26	23.	17	2.2	2.5	20
2-18	1.10	22	24.4	18	4.2	4.9	23
2-25	1.13	20	26.4	18	3.9	4.5	25
3-4	1.09	20	26.6	13	4.1	4.9	20
3-11	1.20	20	26.2	14	3.9	4.5	21
Average	1.15	23	24.5	20	3.2	4.	22
Aeration Unit 2—Circulating Tank with Middle Baffle and 12 Per Cent Diffuser Area.							
1-14	0.96	21	21.1	27	3.	4.	27
1-21	0.50	23	24.5	31	2.	4.	24
1-28	0.67	30	16.5	20	2.6	4.3	21
2-4	0.45	31	18.2	15	3.6	5.3	23
2-11	1.08	25	16.9	17	2.3	2.6	17
2-18	0.62	22	24.4	18	3.5	4.2	23
2-25	0.53	21	26.0	20	2.9	3.6	22
3-4	0.50	20	26.8	15	3.1	4.1	20
3-11	0.66	21	25.8	14	3.4	4.3	19
Average	0.66	23	22.2	20	2.9	3.8	22
Aeration Unit 3—Circulating Tank with Middle Baffle and 10 Per Cent Diffuser Area.							
1-14	0.41	25	25.3	31	1.6	4.3	52
1-21	0.49	27	20.4	39	1.6	7.6	47
1-28	1.25	35	13.7	21	2.7	4.	19
2-4	0.81	25	21.1	19	2.7	...	24
2-18	0.41	22	23.8	20	3.	8.1	25
2-25	0.68	21	26.2	19	2.8	3.7	23
3-4	0.72	20	26.8	14	4.	5.	21
3-11	0.59	20	26.2	14	2.6	3.3	20
Average	0.66	24	22.9	22	2.6	5.2	29

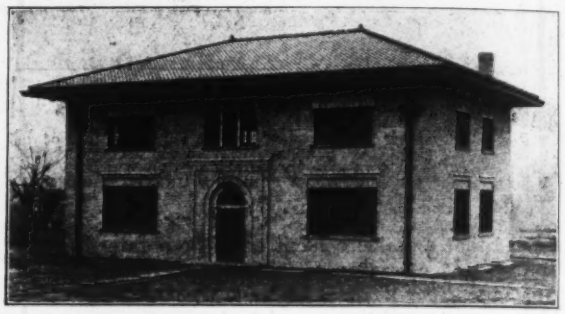
All tanks operating on screened sewage.

section of the plate area. The recesses are formed in the concrete by the use of cast-iron cores joined together by structural-steel framework to insure alignment and uniformity in settling.

In the construction of baffle and dividing walls in and between the tanks an attempt has been made to take care of expansion and contraction entirely by use of temperature steel. These walls are designed as vertical cantilevers and are horizontally reinforced for temperature with percentages averaging 0.5 per cent of the sectional area and distributed from 1 per cent in the thin sections at the top to 0.25 per cent in the heavy sections at the bottom. Copper expansion joints of special construction are located in the influent and effluent channels. The maximum length of continuous wall in an east and west direction is 200 feet.

Operating Gallery—In the design and construction of the operating gallery, which includes the mixed liquor channel and the aeration effluent and sludge piping, special provision has been made for the distribution of mixed liquor without air agitation. This has been accomplished by careful proportioning of the channel sections and taking advantage of the short and direct connections between the aeration and settling tanks. The main air-supply line passes through this gallery and individual meters are provided with indicators and recorders for each tank. The aeration effluent is measured by Venturi meters placed in the connecting lines. Indicators and control devices are placed on the separate settling tank sludge lines in order to control the sludge returning to the system.

Activated-Sludge Settling Tanks—Considerable study has been given to the separation or settling of the suspended solids from the aeration effluent. It has been

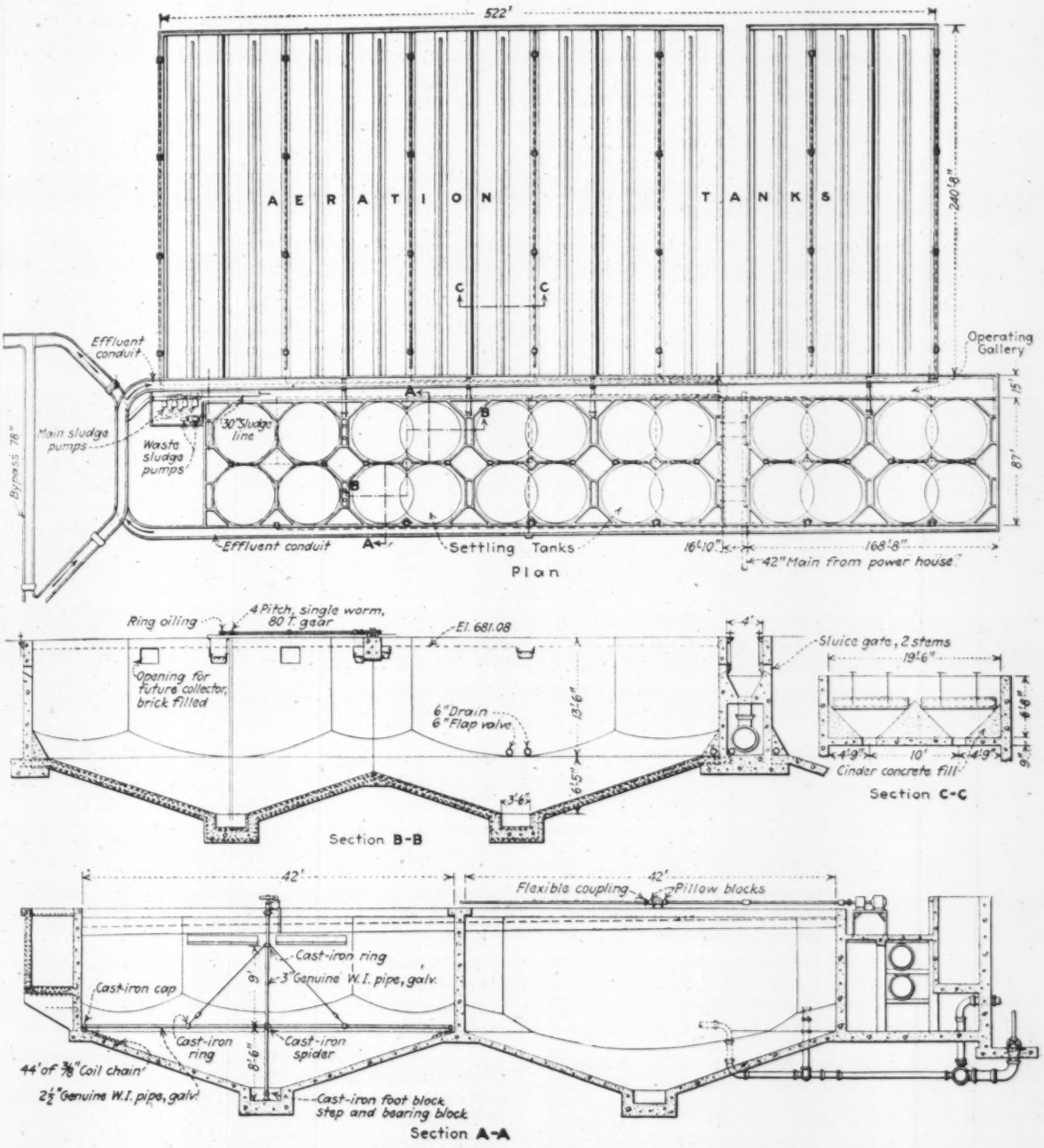


ADMINISTRATION BUILDING WITH OFFICES BELOW AND LABORATORIES ON SECOND FLOOR

realized from the work done that this problem is only indirectly related to the settling of raw sludge and the type of equipment which will operate satisfactorily on one may not produce good results in the other. We are convinced from our experience that activated-sludge settling tanks should be relatively deep and that the sludge should be removed promptly and without agitation. The influent should enter at either end and near the top and the settling cones be located as close as possible to the influent openings. This arrangement permits vertical settling and allows the coarse and heavier particles in falling through the partially settled sewage to carry down the fine solids and colloidal matter which may have a tendency to rise or remain in suspension. The clarified effluent should be drawn from near the middle and at the surface with sufficient weirage provided to take advantage of surface tension.

The Indianapolis plant has been designed with liberal settling capacities. Two settling tanks are provided for each full size aeration unit. Each tank is 78 ft. long, 42 ft. wide, oblong in plan, and has an area of about 3,020 sq.ft. Two settling cones are provided for each tank, with slopes one vertical to three horizontal. The final effluent is withdrawn from the tanks by three surface skimming troughs, each provided with two adjustable weirs giving a total length of 250 ft. for each tank.

Under normal or average operating conditions, each settling unit will receive sewage at the rate of 4.16 m.g.d. plus the returned sludge. On this basis they will



PLAN AND SECTIONS OF ACTIVATED-SLUDGE PLANT FOR CITY OF INDIANAPOLIS

operate at 1,380 gal. per day per square foot of area or, including 20 per cent returned sludge, 1,650 gal. per day per square foot. With an assumed maximum demand of 50 per cent this rate will be increased to 2,340 gal. per square foot of area. The settling period under average conditions and including 20 per cent returned sludge will approximate 97 minutes and for the extreme maximum condition 53 minutes.

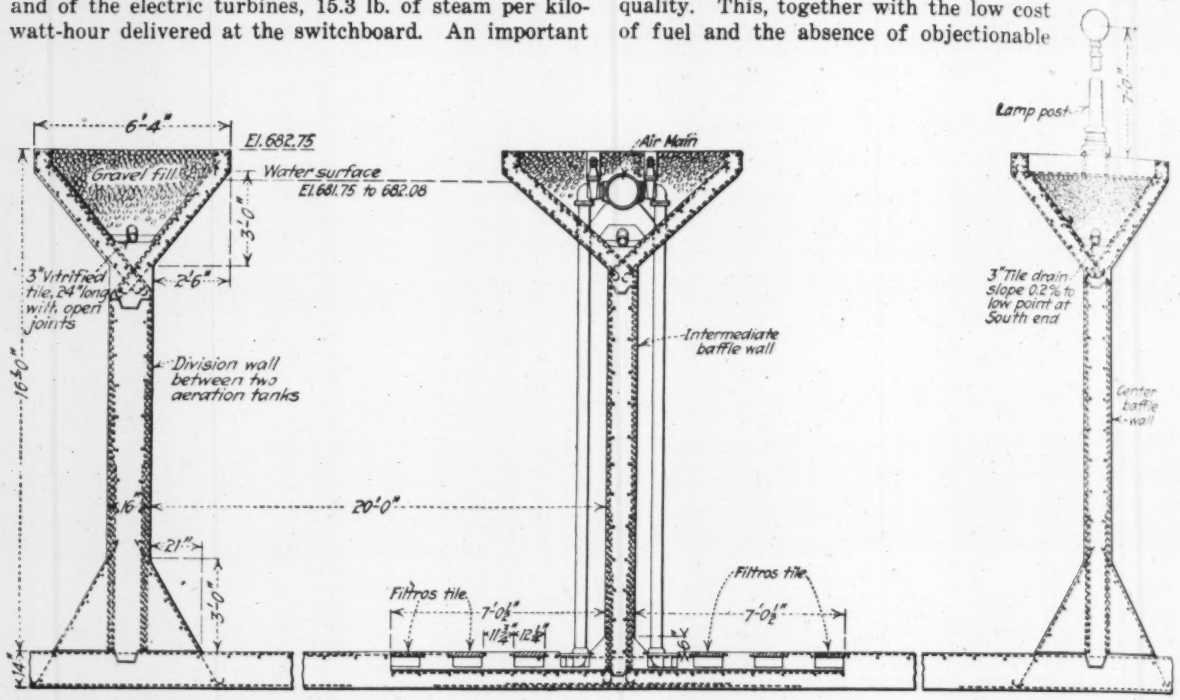
The sludge removal mechanism consists of two revolving elements for each tank (two units being driven from a single motor). Sweeping chains are provided to keep the sludge from adhering to the bottom. By producing a slow rolling movement of the sludge these chains assist in concentration in the cones. Each double tank is equipped with one 2-hp. electric motor which is direct-connected to the revolving element through spur-reduction and worm gear drives. The rate of rotation of the elements is one revolution each 19 minutes.

Main Power Plant—Electric power and air for the plant operation are furnished from the main power building located adjacent to the activated-sludge plant. In this building provision is made for eight 400-hp. water-tube boilers, four steam-turbine blowers and three steam-turbine generators and necessary auxiliary equipment. At the present time three boilers, three blowers with a capacity of 18,000 to 24,000 cu.ft. per minute and

two 500-kw. electric generators are being installed. The boilers will furnish steam at a working pressure of 225 lb. per square inch with a superheat of 100 deg. F. The guaranteed economy of the turbine blowers is 7.67 lb. of steam per 1,000 cu.ft. of air at 7.5 lb. gage pressure and of the electric turbines, 15.3 lb. of steam per kilowatt-hour delivered at the switchboard. An important part of this plant is the air-washing equipment for the air supply to the blowers. It is guaranteed by a double system of washing to remove at least 99 per cent of all dust and floating particles contained in the air before washing.

Air Piping—The connecting air main between the power plant and the aeration units is 42 in. in diameter and contains the master air meter for integrating and recording the total quantity of air furnished. All air lines are cast-iron hub-and-spigot pipes in which provision is made at various points for expansion and contraction. These pipes are all heavily coated with a high-grade pipe varnish to prevent the air coming in contact with the iron. No steel is used in any of the air lines.

Sludge Dehydration—It is agreed that dehydration of activated sludge is a troublesome problem. Much research work has been done but as yet no universal method has been developed or adopted. Hydrogen-ion control seems to offer encouragement with some classes of sludge but with the character of sludge produced at Indianapolis, the problem is believed to be largely biological. From the records obtained from dehydration of sludge at other laboratories and demonstration plants, it is apparent that the Indianapolis sludge is of superior quality. This, together with the low cost of fuel and the absence of objectionable odors, was one of the determining factors in deciding on the activated system of sewage treatment.



ENLARGED CROSS-SECTION OF ACTIVATION TANK: DETAILS OF PIPING, FILTROS PLATES, BAFFLE WALLS

Throughout the work at the demonstration plant many tests and experiments were made on sludge filtering. Both plate presses and continuous filters were used for this purpose. Either of these types gave reasonably good results when the sludge was properly conditioned, but did not produce a dense or satisfactory cake when the sludge was under aerated or otherwise out of condition. During the summer of 1922 sludge was dried on sand beds. In favorable weather a cake 1.25 in. thick containing an average of 88 per cent moisture was removed from the beds each 24 hours.

Dehydration Plant—On account of the uncertainty of this operation and the lack of experience on full size units, it has been considered advisable to construct the building for the dehydration plant, but without complete filter equipment. Dryers are to be installed for the concentrate thickener sludge and for activated sludge removed from sand beds which are intended to be used temporarily or until final dehydration methods are determined. This building will be 100x120 ft. in plan and will include two indirect rotary dryers 88 in. in diameter by 60 ft. long, equipped with induction fans, chain grate stokers, vapor condensers and dust collectors. Provision is made in this building for an additional drying unit and floor space 42x120 ft. for sludge filters or other means of dehydration. At present two full size continuous filter units have been purchased. One of these is a vacuum filter, the other of gravity type. It is intended that these units will be placed in service and the dehydration system fully developed under actual working conditions of the plant.

TABLE III—RESULTS OF DEHYDRATION OF ACTIVATED SLUDGE WITH OLIVER FILTERS

1922	Drum Speed r.p.m.	Run, Hr.	Solids: Influent Per Cent	Solids: Cake Per Cent	Solids: Effluent p.p.m.	Wet Cake Total, Lb.	Sludge 10 Per Cent 100 Sq.Ft. per 23 Hr.
July 14-16.....	6.5	57	2.21	18.81	31	3,397	2,760
17-22.....	10.5	126	2.50	18.56	29	4,923	1,903
July 27-Aug. 3.	10.5	97	1.66*	18.80	27	2,593	1,272*
Aug. 29-Sept. 5	10.5	104	1.54*	18.17	22	3,181	1,172*
Averages.....			1.98	18.59	27	....	1,777

*The low production of the last two runs is accounted for by thin sludge due to insufficient settling capacity during this period.

Some Notes on a Brazilian Hydro-Electric Plant

Special Correspondence

ELECTRIC energy for the use of the city and State of Rio Janeiro and the federal district of Brazil is generated in a high-head hydro-electric plant about 45 miles from the city. An account of a recent trip to the plant arranged by the Club de Engenharía may give some idea to the readers of *Engineering News-Record* of the development in water power in this part of South America.

The railway transportation for the 45-mile trip over the Central of Brazil Railway was arranged by the club, with Fred Huntress, vice-president in charge of the Rio Janeiro Tramway Light & Power Co., as chief host for the visitors. From Lages station on the railway (gage 1.68 meters) the trip to the power house was made by a special car and locomotive of the company. The distance is about 13 miles, and the line is generally through very low land that was a hot bed of sickness, malaria and other fevers when the company began construction. Men sickened and died so quickly on the other railway construction near by that it was almost impossible for the company to employ men when their railway construction began. Steps were taken as rapidly as possible to kill mosquitoes near the company works but it was very difficult to secure co-operation from the land-owners near by. It therefore became necessary to purchase an enormous tract of land and put a mosquito expert in charge. At the present time fevers and mosquitoes are practically unknown anywhere near the company works.

The party left Rio de Janeiro at 7:30 a.m. and reached the power house at 10 a.m. where inspection was made of plant and equipment.

Hydro-Electric Plant—The electrical equipment is principally Westinghouse. There are some Escher Weiss hydraulic equipment and Pelton wheels. The working head is of course variable with the season but at present it is about 304 meters. One of the wheels was idle for a short time and it was very interesting to note the conditions of the buckets. In many instances they had been very badly worn out but had been built up by electrical welding and later ground smooth with abrasive wheels. The phosphorus bronze nozzle center showed signs of considerable wear, both as uniform channels and as a succession of small ovals which would ultimately form channels. There are now eight wheels and the load in Rio de Janeiro averages about 900,000 kw.-hr. per day. At times it is over 1,000,000 among the 80,000 light and 4,000 power customers. An outdoor substation supplies the State of Rio de Janeiro, in which the plant is located, and there is a small interior department of the power house distributed to the works, the near-by farms and towns.

Water is wasted through the nozzles at times and strikes a small hill across the river where some very neat cylindrical tunnels have been driven into the rock with water at about 400-lb. pressure. It is in no sense a novelty to those who have similar barriers but is one of the things which always interests the visitors.

The power house employees have very fine quarters near the plant, entirely screened as at Panama with beautiful gardens round about.

To reach the upper plateau from the power house, a 66 per cent cable incline over a stone-paved roadbed is used. The faces of the cuts are painted with a gas house tar to protect the earth against vegetation, rain and the burning sun. It has given general satisfaction and is a well established custom in various parts of Brazil.

From the top of the incline to the general office and home of the director of the works the distance is about three kilometers by a very good earth road. This is the ideal country home with a farm and excellent orchard alongside, telephone connection to nearly every city, town or farm within 200 miles, radio receiving set for the opera in Rio and the best papers and magazines from a half dozen countries.

Fast teams of round little mules took us to the dam which is on a radius of 100 meters and 45.50 meters high. It was built under the direct supervision of C. H. Kearny of San Antonio, Texas, and stores 210 million cubic meters. The lake is very surprising as it follows a narrow canyon for nearly 20 miles and runs back into many tributary gulches. One can throw a stone across in many places. The company's power boats travel along rapidly and one can see most of it in a short time.

The property is exceedingly well managed and throughout the organization an esprit de corps exists which many managers might well envy.

Relation of Railway Wheels and Rails

THAT THE TAPER of wheel treads is a very small factor in the relation of rail heads to wheel treads is shown in the report presented by the committee on Wheels at the recent Chicago convention of the mechanical division of the American Railway Association. The note in question, abstracted below, relates to a joint meeting of this committee with the American Railway Engineering Association's committee on Track Stresses.

In a full discussion of tread design of wheels and its relation to the canting of rails, it developed that there is little information as to small or large taper of wheels in its effect on the rail. It was brought out that the spreading of rails and the wearing into tie-plates and ties on the outside is a serious problem and that many railroads are meeting this by canting the rails. Some of the engineers have felt that the wheel tread should have a lighter taper than 1 in 20 in order to help relieve this condition. But wheels and rails both wear quickly after being put into service and any relation between the tread contour and the contour of the rail is soon lost. Thus it would not appear likely that a slight alteration in the taper of the wheel would remove this condition. Furthermore, the main cause of the spreading of the rail is entirely independent of the tread taper.

The committee of the engineering association asked as to the possibility of any change in the taper of the wheel, in order that it might have a permanent basis for a recommendation for canting the rails. The committee on Wheels stated in reply that it has received no data which would warrant making a change in the taper of the wheel tread. The present taper is thought to be most advantageous, as regards flange wear. The last change made was in 1907, when the taper was changed to 1 in 20 from 1 in 25. At the present time, practically all wheels (except those for a few roads) are being made with this standard taper. The committee advised the A. R. E. A. committee that it had under consideration the making of the tread with a single taper of 1 in 20 instead of the present double taper, and this procedure met with the approval of the latter committee.

Geology and the Decatur Dam and Reservoir Project

Glacial Formation Explains Why Sheet Piling Could Not Be Driven to Intended Depths —Watertightness Assured

By Morris M. Leighton
With Illinois Geological Survey, Urbana, Ill.

EXPERIENCE has taught the engineer that the construction of a dam across any valley in the glaciated area must be undertaken with unusual caution. The materials beneath the dam must have sufficient bearing power to support the weight of the dam, and must be tight enough to prevent seepage from beneath. The materials at the ends of the dam and in the natural walls of the reservoir must also be such as to prevent excessive leakage. In order to pass judgment upon the character of glacial formations at a given locality, having in view a reservoir project, the engineer desires to know the kinds and thickness of materials present, their texture and compactness, the relationships of the porous to the non-porous and their relations to the bedrock. Obviously a full knowledge of these things involves an understanding of the principles of glacial and aqueo-glacial sedimentation and in some cases the differentiation of drift-sheets.

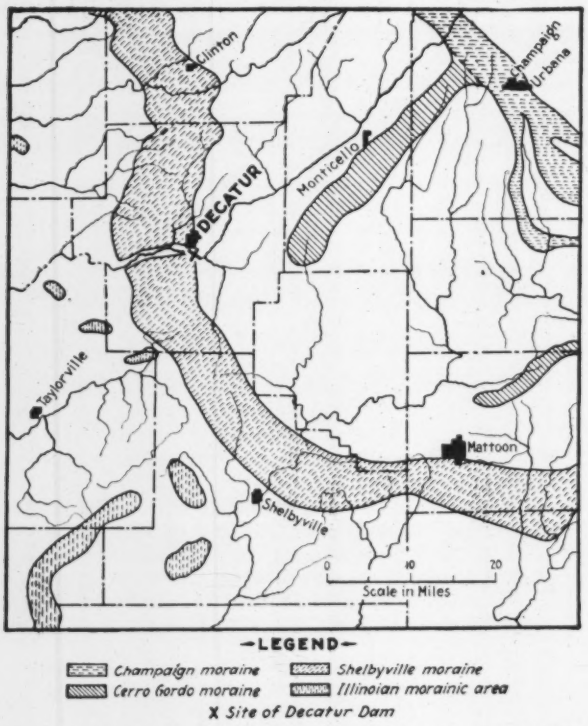


FIG. 1—THE GLACIAL GEOLOGY OF THE DECATUR AREA

At Decatur, Ill., a new dam has been constructed across the Sangamon River, which flows through the city, thereby creating a reservoir in the upstream portion of the valley for a distance of 12 miles and covering 3,900 acres of territory. The specifications called for a dam 15 ft. high above the old river level; and for the base of the dam to be 72 ft. wide, which is inclusive of a concrete apron but exclusive of a 30-ft. clay apron on the upstream side. The base was to extend to a depth of 3½ ft. below the lowest part of the river bed, below which cutoff sheeting was to be driven to a maximum depth of 30 ft. below the base of the concrete portion of the dam. The middle section of the dam was to be of concrete, but the end sections of earth, with the cutoff sheeting reaching to somewhat less depth than in the middle section. The supervision of construction was entrusted to the firm of Pearse, Greeley & Hansen, consulting engineers, of Chicago, who assigned J. Albert Holmes to the position of resident engineer.

Before formulating the specifications, a preliminary series of test-holes was made across the valley to ascertain the character and thicknesses of materials. Samples were collected, but due to the fact that these were from a churn drill nothing but sand and gravel was reported. Upon these data the specifications were drawn and the work was undertaken. Later in driving the cutoff sheeting, a "hardpan" at varying depth was encountered which was impossible to penetrate and which prevented the driving of the sheeting to the depths specified.

The question then arose as to what this "hardpan" might be—is it solid bedrock, or cemented gravel, which might be porous enough to permit excess leakage, or some other kind of material which might or might not menace the success of the dam construction or the reservoir project. Obviously it was necessary to have these questions answered, and a geological examination was accordingly requested.

Geological Phenomena—Decatur is situated on the eastern border of the Shelbyville Moraine (see Fig. 1), which here has a width of several miles. No bedrock is exposed in this vicinity. The altitude of the moraine at the river bluff is reported to be about 650 ft. above sea level. The valley at Decatur is about 50 ft. deep, but farther west in the moraine it is 75 ft. or more. West of the moraine it is scarcely over 50 ft. but is much wider than in the moraine. This seems to indicate that the portion beyond the moraine is pre-Wisconsin in age, quite in harmony with the fact that some of the tributaries are beheaded by the Wisconsin deposits. The incision of this part of the valley in Illinoian drift would therefore make its age post-Illinoian and pre-Wisconsin.

Frank Leverett ("Illinois Glacial Lobe": U. S. Geol. Surv. Mono. 38, p. 518, 1899) states that the average thickness of the Shelbyville drift is 100 ft., an estimate based on the relief of the moraine. If this were the case, it would seem that the valley through the moraine must have been completely filled, but this figure seems excessive, and there are reasons for believing that the valley was not buried.

After the hardpan was discovered a new series of

TABLE I—GENERALIZED SECTION OF THE STRATA IN THE SANGAMON RIVER VALLEY NEAR DECATUR AS DETERMINED FROM BORINGS AND TEST PITS

	Description of Strata	Thickness, Ft.
3.	Soil and flood-plain alluvium, a brownish sandy silt toward the valley walls, becoming darker near the stream	5–10
2.	Sand and gravel, distinctly sandy, thins out toward the valley walls, thickens toward the stream, maximum thickness	35
1.	Till, called "hardpan" by the drillers, dense, compact clay with scattered pebbles and boulders, difficult to penetrate; contains a few thin layers of sand, most of them limited in thickness from 1 to 2 ft., but one on the south side having a maximum thickness of 13 ft. Maximum thickness of till penetrated	54

well borings was made—this time in such a way that cores of the material, as it actually occurs, were taken at desired intervals. Credit for the admirable way in which this series of borings was made belongs to Mr. Holmes. Twenty borings were put down across the valley in line with the proposed dam. These revealed the strata, as shown in Fig. 2.

A short distance farther west, in the moraine, a new sewage ditch had exposed some excellent sections of drift for study. Here the till contained thick lenses and considerable bodies of gravel and sand, some of which show marked contortion by the overriding ice. One of these lenses was about 200 yd. long. If such a lens were to occur in the till beneath the dam, it might permit excess leakage. But the till beneath the dam appears in the main not to belong to the Shelbyville terminal moraine, like that shown in the sewage ditch, but to belong to the Illinoian ground moraine. If so, then by virtue of its mode of origin chiefly beneath the ice, it would likely contain but little gravel. Instead, its constitution would be chiefly till, possessing a clayey matrix nearly impervious to water. The evidences that the till beneath the dam is chiefly Illinoian in age will now be considered.

Superposed Drift-Sheets in the North Valley Wall—In the north valley wall at the dam site, the construction company opened a clay pit for securing clay filling. An unusual section was exposed, showing the following sequence:

3.	Till (probably Wisconsin) overlain by "wash" from the slopes and capped with soil; upper part, including "wash," is leached 3 to 4½ ft., the underlying 0 to 2½ ft. being calcareous; total exposed	4½–7 ft.
2.	Old soil	6–8 in.
1.	Till (probably Illinoian), gray below the soil, brownish below, leached 3 to 4 ft., calcareous below, compact; total exposed	6 ft.

Quite clearly, this section shows two distinct till sheets, separated by an old soil and the lower till exhibiting decisive evidence of leaching and oxidation before the deposition of the overlying till. The upper till doubtless belongs to the Shelbyville terminal moraine of Early Wisconsin age, the lower to the Illinoian drift-sheet.

A short distance west, there was a ditch excavated for the cutoff sheeting, which transects the valley slope Upon examination this was found to show the same sequence of materials. Here, fortunately, the trend of the exposure is at right angles to the valley and shows the relation of the pre-Wisconsin surface to the valley. The contact between the two tills dips steeply toward the valley in conformity with the present north valley wall, strongly suggesting at least two things: (1) That the north side of the old Sangamon valley at this place was not completely filled by the Shelbyville ice deposits, and (2) that of the amount which was deposited on the north side, little remains from the erosion of the present stream. By projecting the contact into the valley, its position would be such as to make most of the till beneath the gravel filling referable to the Illinoian deposit. Hence, it appears that the sand and gravel filling rests almost directly on Illinoian drift with but little Wisconsin drift intervening. Further evidence was found by a study of the excellent series of core samples from the later series of borings. Some of those from the middle portion of the present valley showed brown till, partly below blue till and partly directly below the sand and gravel filling.

The South Side of the Valley—The south side of the valley was filled with greater quantities of drift, which accounts for the present valley being narrower than one would expect, judging from the width of the valley beyond the moraine. No exposure of an old till or no evidence of the old valley wall was found on the south side. All of the material, save for a thin mantle of loess, appears to belong to the Shelbyville drift. As will be seen in Fig. 2, there is a body of sand and gravel, revealed by four borings, separating the blue Shelbyville till above from the brown Illinoian till below. This is interrupted as a part of the outwash of the advancing Shelbyville ice, which later was overridden and buried by the deposits of blue till.

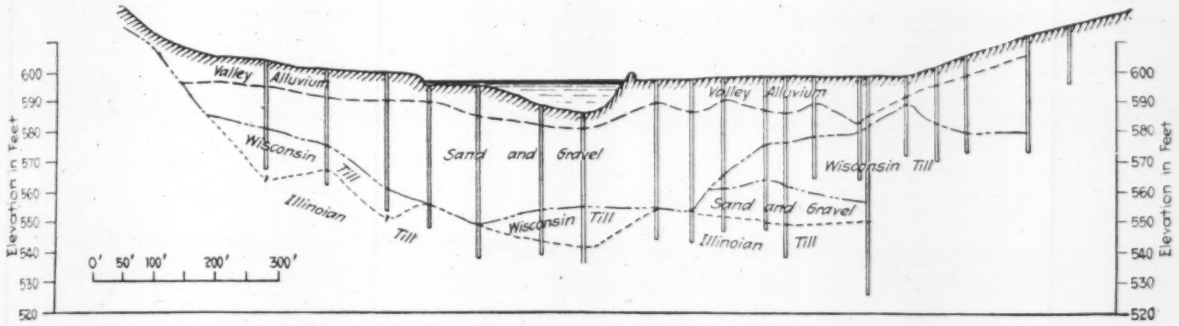


FIG. 2—CROSS-SECTION OF THE SANGAMON RIVER VALLEY AT DECATUR

The sand and gravel filling in the Sangamon Valley has already been noted. No distinct terrace is shown at the dam site, but on the south side of the valley slightly above the present flood plain, gravel underlies alluvium and "wash" from the south slope. All of this gravel filling is believed to be correlative with the remnants of gravel terraces which occur both upstream and down, and which appear to have been deposited as a valley train from the ice during its recession from the Shelbyville moraine and during the building of the next younger Cerro Gordo moraine. (Fig. 1.)

Summary of the Sangamon Valley History at Decatur—The valley dates back to the Sangamon interglacial epoch, probably even to the close of the Illinoian glacial epoch. Upon the melting of the Illinoian ice, the area was a flattish ground moraine, and the Sangamon River was formed by the consequent drainage. During the Sangamon interglacial epoch a relatively broad, shallow valley was carved at Decatur commensurate with that portion of the valley beyond the Shelbyville moraine. Contemporaneous with the valley cutting, the Illinoian till above river level was leached and oxidized and soil was developed, extending down some parts of the valley

slope. To some extent beneath the old flood-plain the till was oxidized to a brownish color but scarcely leached.

The change of climate from warm to cold and the accumulation of a great thickness of ice over eastern Canada resulted in the Wisconsin ice invasion, which reached its extreme limit a few miles west of Decatur. During the ice advance glacial waters deposited the body of sand and gravel which lies between the two tills on the south side of the valley. Later this was overridden and for a time the ice edge remained within the zone now occupied by the Shelbyville moraine and radically changed the contour of the Illinoian surface by depositing a notable moraine. Some of the débris was released directly from the ice upon its melting and deposited as unassorted drift or till, while some was deposited by glacial waters, forming gravel bodies. Readvances of the ice contorted the gravels and buried them with till. As a result, the moraine was formed of both till and bodies of sand and gravel with complex unpredictable relations.

The amount of drift deposited across the valley was not enough to fill and eradicate the valley. A depression was left to serve as a drainage line upon the retreat of the ice front. In this inherited depression, after some modification by the glacial waters, a valley train was deposited, which came from the ice during its melting back from the Shelbyville moraine and during the building of the Cerro Gordo moraine. Since the disappearance of the ice, the sand and gravel fill has been partly eroded away and a flood plain of varying width has been developed on both sides of the stream.

Relation to the Reservoir Project—According to the foregoing interpretation, the hardpan, or glacial till, on the north side of the valley, which is to receive the cutoff sheeting, is drift of the Illinoian ground moraine and not drift of the Wisconsin terminal moraine. Since the drift belongs to the ground moraine phase, it was deposited chiefly beneath the ice and consequently has a maximum content of impervious clay matrix and a minimum of sand and gravel layers which might serve as avenues of sub-surface leakage. On the south side of the valley, the cutoff sheeting ends in the Wisconsin drift. The gravel body, 6 to 13 ft. in thickness, which separates the Wisconsin and Illinoian tills, is apparently the only one which menaces to any degree the success of the dam. Due precaution was taken by the resident engineer, who, realizing the possibility of some excess leakage at this place, made provision for such an emergency.

Vancouver Dock Work Revived

The Vancouver drydock project, which was suspended for several months, has been revived and the Wallace Drydock Co. has been awarded the contract. The drydock will be of the floating type, to cost $2,500,000, and will be built on the north shore of Burard Inlet, opposite Vancouver. The construction program is subsidized by the federal government. The plans call for a 15,500-ton drydock, 500 ft. long by 132 ft. wide, in two sections, each containing five pontoons 44 ft. long, constructed of heavy timbers; a third section will give a total length of 700 ft. A 700-ft. pier, 50 ft. wide and placed on concrete cylinders, is to be built alongside the drydock. Steel machine shops, to be erected, will house a 30-ton traveling crane, and the pier will have a 7-ton traveling crane.

An Optical-Lever Extensometer of Wide Utility

Abstract of a paper by L. B. Tuckerman, Bureau of Standards, at the recent Annual Meeting of the American Society for Testing Materials.

A STRAIN-GAGE or extensometer of small size, high sensitiveness and convenient adaptability to various uses has been developed by Dr. L. B. Tuckerman, of the Bureau of Standards. It uses a Martens tilting mirror, but with a triple mirror in place of the single mirror of the Martens instrument, and couples with it a combined illuminator and reading telescope which eliminates the great

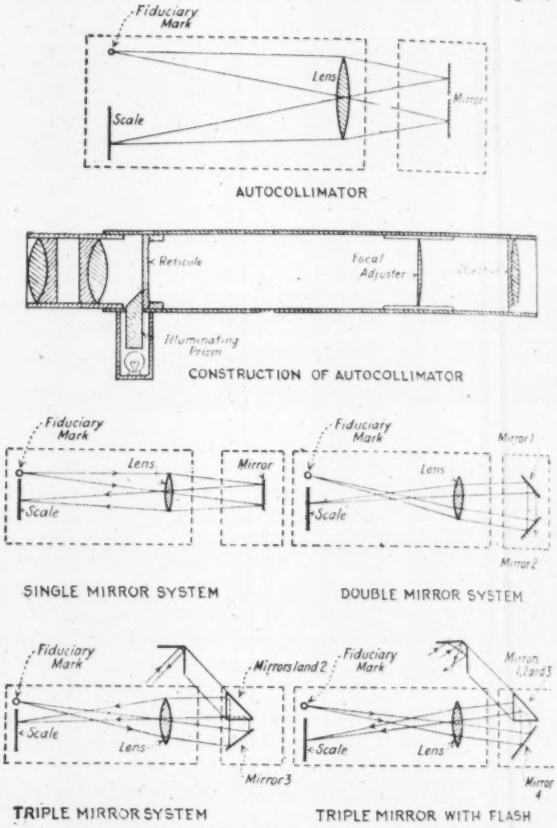


FIG. 1—AUTOCOLLIMATOR AND TRIPLE MIRROR

degree of susceptibility to disturbance of the ordinary optical-lever system. In the instrument as constructed a single scale division represents 1/25,000-in. change of length, and tenths of a division may be read.

In Fig. 1 is shown at the top a diagram of the illuminator and reading telescope combined in a single unit called the

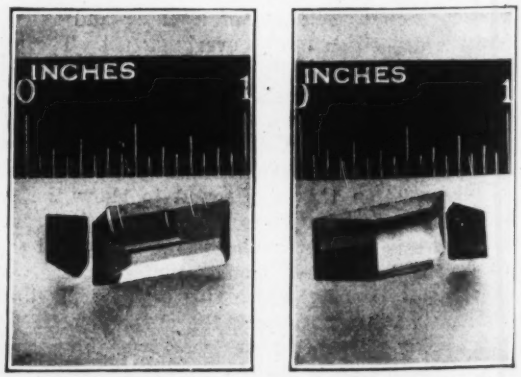
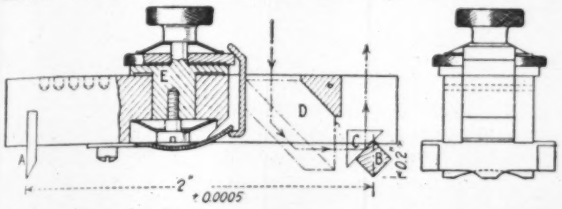


FIG. 2—BACK AND FRONT OF MIRROR PRISMS

autocollimator, a full drawing of which, somewhat diagrammatic, is given just below. This combination makes the reading system entirely self-contained, but the reading is still dependent on the mirror position.

With a single mirror, as shown in the left-hand sketch in the lower part of Fig. 1, the reflected light ray misses the reading telescope upon even a minute shift or tilt. This difficulty is obviated, in part, when a double mirror system is used, as shown just to the right; the telescope then is able to take a reading in any position at right angles to the line of intersection of the two mirrors. In order to make the arrangement also insensitive to disturbances in the other direction, a third mirror is introduced, as shown in the left of the lower line of diagrams in Fig. 1. This is the arrangement used in the Tuckerman instrument, except that for auxiliary purposes a fourth mirror is formed by grinding away the corner of the double mirror unit, as shown in the right.

Prisms are used instead of mirrors, because accurately plane surfaces are more easily obtained in them. Fig. 2 shows the actual prism system used in the Tuckerman



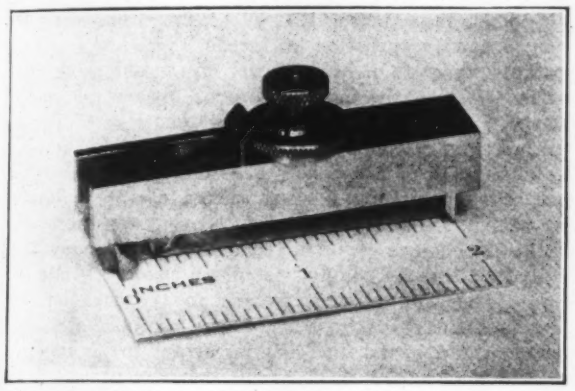


FIG. 3—TWO-INCH STRAIN-GAGE

strain-gage, comprising an ordinary 45-deg. prism as a single mirror (mirror 4 of the diagram), and a roof prism with its corner cut away.

The complete strain-gage is shown by drawing and photograph in Fig. 3. The knife-edge *A* is fixed, that at *B* is the tilting knife-edge carrying the mirror prism. The roof prism *D* is carried on a lever whose position may be adjusted by a double cam *E*, giving a coarse and a fine adjustment in order to bring the fiduciary mark of the vernier to zero on the scale. The Martens lozenge *B* is 0.2 in. high, and with this construction one scale division represents 0.00004 in. deformation.

A photograph of the field of view obtained with the collimator is reproduced in Fig. 4. The image of the scale and the vernier reflected alongside it is seen in the center of the field; as will be seen, tenths of a division may be read. The bright patch at the top of the field is the "flash," which is an image of the collimator field reflected from the beveled corner of the roof prism. So long as this flash is in the field of view, the autocollimator is close enough to the true right-angle relation to the strain-gage mirrors to make the cosine error negligibly small.

Several of these small strain-gages have been constructed by the Naval Gun Factory, Washington, for tests on large riveted joints for the navy. It is planned to place thirty of the strain-gages at various points on the riveted joint, and read them by means of two autocollimators.

It is believed to be possible to apply this strain-gage to

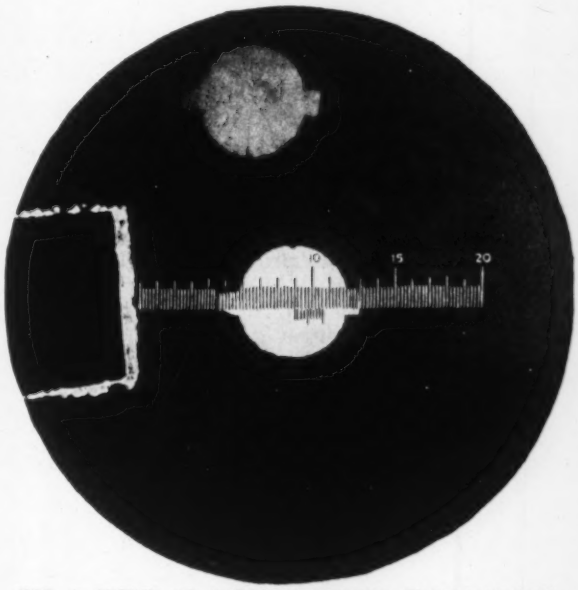


FIG. 4—FIELD OF AUTOCOLLIMATOR, FLASH AT TOP

gage lengths even as small as ¼ in. for fuller exploration of deformations in strained members. The light weight of the gage also makes it applicable to many cases of strain measurements where heavier instruments cannot be used, as in the case of thin sheet metal or wire. The gage is now being adapted to a torsion dynamometer for rotating shafts at the Bureau of Standards, and still other applications are in contemplation.

Another Cross-Connection Typhoid Outbreak

Only seven months after the typhoid outbreak at Franklin, N. J., due to cross-connection between a municipal and an industrial water supply, states the New Jersey *Public Health News* for June, 1923, another typhoid outbreak has occurred that seems to be due to almost identical conditions. The record outbreak was in Rockaway. From the onset of the first case on May 25 up to June 25 there were 41 cases and 4 deaths. The record down to July 31, according to D. C. Bowen, chief of the Bureau of Local Health Administration, was 46 cases and 6 deaths. The cases are confined to the eastern end of the borough, beyond a point where there was a cross-connection with the fire mains of an industrial plant, separated from the potable supply by a single check valve. Examination showed that this valve was "stuck open and so encrusted with dirt and rust that the flap could be moved only by the use of a bar." Formerly the town pressure exceeded that in the industrial water-supply system. Examinations made under the direction of Mr. Bowen showed that the industrial water supply received the effluent from a septic tank located only some 200 ft. upstream from the pump intake. It was also found that at the time the infection occurred the excretions from a typhoid carrier of three years' standing were going into the septic tank. Action taken to control the outbreak included severance of the pipe forming the cross-connection, which was done on June 16, abundant use of bleaching powder in the privies of the borough, disinfection of the discharges of all typhoid patients, and free inoculation with anti-typhoid bacteria of all residents of the borough who would accept it, the latter being offered by the local board of health

Recent Railway Location in Southern Colombia

Difficult Problem of Linking Up Cities in the Andes Mountains—Providing an Outlet to the Sea—Lack of Transportation Facilities—No Local Subsistence

By F. R. Molther
Former Office Engineer, D. E. Wright Construction and Engineering Co., Inc., Panama

ALTHOUGH the theory of railway location rarely comes up in present-day engineering practice in the United States, it has never diminished in importance nor been backward in development. It is believed, therefore, that the following article will be of some technical interest describing as it does some location problems presented by the difficult topography of the Andes, where as much as anywhere in the world the country calls for a good understanding of railroad requirements. In addition to this, the fact that American engineers and American capital are continually finding Latin-America a broader field for their development may also add to the interest in the discussion.

THE VALLEY OF THE GUAMBUYACO RIVER BETWEEN PASTO AND POPAYAN

Transport Situation in Colombia—The Republic of Colombia, situated at the northern extremity of the South American continent, possesses great natural resources the development of which is limited, however, by the extreme lack of transportation facilities.

It is to be expected that plans for the betterment of such limiting conditions are both numerous and extensive. Because of a loosely jointed central government, unable to project its influence to the more distant and inaccessible states, plans for better transportation vary greatly and each of them is sponsored by those areas which would be best served by it. The decision as to the encouragement of some plan or another is a problem that confronts every administration at Bogota.

Recent Railway Projects—One of the earliest railway projects was that of connecting the capital, Bogota, a city of 150,000 people on the great Cundinamarca plateau 8,000 ft. above the sea, with the Pacific Coast at the port of Buenaventura. This work was commenced in 1877 by Francisco Cisneros, the most prominent railway engineer in the history of Colombia, and the road is now in operation as far as Buga. At the important city of Cali, in the heart of the extensive and fertile valley of the Cauca, a branch toward the south has been constructed to within 50 kilometers of Popayan, an active city of 15,000 inhabitants, capital of the department of Cauca, and a thriving center in a cattle and coffee producing region, with a climate suitable for raising potatoes and wheat. Recent consideration of the importance of better communication among the departments of the country has given rise to a study of the continuation of this branch to the frontier of Ecuador, by way of Popayan, Pasto, capital of the department of Nariño, and the important towns of Tuquerres and Ipiales in the same department.

Another, but wholly new proposal for railroads in the isolated department of Nariño, which is now without a single kilometer of railroad, is that of connecting the capital city of Pasto with the Pacific at the port of Tumaco.

The contract for the location of these two lines, from Pasto to Tumaco, and from Popayan to Ipiales, on the frontier, was let in September, 1920, to the Wright Engineering and Construction Co., Inc., of Panama, and the work was completed in August, 1922. The purpose of this article is to indicate the location problems and solutions applied on the surveys for these lines, without consideration of their particular importance, the discussion of that question requiring recognition of all the many routes proposed for better transport facilities in Colombia.

These surveys were made by three organizations operating independently each consisting of a chief of party, transitman, levelman and topographer. In very rough country, of which these routes were required to cover many kilometers, two topographers were employed, and the use of a field draftsman in one party seemed to justify this addition to the staff. Two Colombian engineers were employed in each party, as required by the contract, usually as topographers or

levelmen and despite the limitations of rudimentary training and inexperience they generally gave satisfaction. Several Panamanian negroes were brought down to serve as chainmen and rodmen, but proved to be of greater value in the kitchen, and finished the work as cooks. Native peons were developed into competent chainmen and rodmen.

Because of the isolation of these commissions while in camp, away from towns and traveled roads, it was necessary for each camp to be self-sufficient, and to carry all of the supplies needed for any contingency, in addition to the technical equipment.

All supplies that could be so accommodated were packed in wooden boxes 31 x 17 x 12 in. deep, experience having determined that these were of the most convenient size and weight for the little Colombian pack animals to carry in pairs. Each man on the staff was allowed one such box of personal equipment, without shoes, which alone constituted half a cargo, for no amount of hobnails could prevent cutting the best boots and shoes to pieces on the rocks, or pulling out the seams on the steep slopes.

In territory infested with mosquitoes or gnats, each man had a mosquito bar of thin muslin, and not only was sleeping made quite comfortable, but most of the party also escaped malaria. The peons, however, who slept without mosquito bars, suffered greatly from fever, and many pounds of quinine were required to keep them in working condition.

The cook had horses and pack-animals for trips to market—held weekly in the small villages that were usually two days' trip from the camp—which afforded fresh meat, fruit and vegetables. Staple groceries were obtained monthly from the nearest large town, sometimes a journey of two weeks away. For several months the inaccessibility of markets, and the large force of peons employed, required butchering in the camp. Beef was usually killed at the end of the week, and pork or sheep at more frequent intervals. Chickens, sheep and pigs were carried by the camp party, and driven from camp to camp if not consumed at once. For several months game solved the question of fresh meat, one peon serving as hunter. Often deer or antelope were brought in three or four times a week. Wild turkey and ducks also were available for food.

Camps were built at intervals of about every 15 km. as it appeared undesirable to have the field parties cover a greater distance in so precipitous a country, with no paths other than cattle or antelope trails. Occasionally the topography recommended the use of temporary "fly" camps in which the party sometimes stopped for a night or two to avoid a particularly dangerous journey through canyons and over precipices to the main camp. Camps were built of wild cane, using the stalks to form the walls and one end of a rectangular structure having a ridge roof thatched with cane leaves. This resisted the rain in the arid country through which much of the survey was run. As the rainy season advanced, however, it was occasionally necessary to reinforce the roof with a tent fly lashed over the thatch. Beside such a house for the staff, a shelter was also constructed for the cook and his helpers, and two for the peons, or laborers.

All moves from camp to camp were made by pack-trains, which by reason of inadequate roads often were unloaded to pass the cargoes around some narrow section of trail which a loaded animal could not pass.

Although the topography of the route was very broken, and several times the line ran close to those traditionally inaccessible sites selected by eagles and condors for their nests, the familiar method of reading angles with a transit and chaining the distances was employed in location. Levels were taken with a wye-level at every 20-m. station, except when steep canyons justified the location of an elevation on the far side with the instrument, and the use of a Locke level to fill in the descent and the rise. From these elevations the topography was taken in a 200-m. belt, half on each side of the line, the even contours being picked up with the Locke level, and located by pacing or measuring with the rod. For a stretch of seven kilometers in the Guambuyaco Canyon, the route of the projection was impossible for the instrument and chain. Here the survey line was run at the bottom of the canyon, on

MOVING THE DRAFTING OFFICE

such banks as the stream offered, but often in the river itself. Topography was taken by stadia, employing the vertical and horizontal angles, and the mapping was done by interpolation between these miscellaneous elevations at the tops of banks and noses of ridges, to arrive at the even contours.

In order to accommodate as much of the line as possible on comparatively narrow sheets, the latitude and departure of each course were determined from a chart, and all critical hubs, at points where the general direction of the survey changed greatly, were computed and plotted at 1:10,000 scale. Selecting a meridian for each sheet, the hub for starting was located in the most advantageous position for accommodating as much line as possible, and the hubs were plotted at 1:2,000 for the detail study. The courses were run off by determining their angle with the meridian of the sheet, and by drawing in their direction, with respect to this meridian, by the method of tangents and co-tangents (*Engineering News-Record*, Dec. 14, 1922, p. 1032). The topography was then spotted on at each station where sections had been read and the contours were sketched on from the field book, which contained the contours drawn in between the sections where elevations were read. This permitted the covering of all small breaks in the ground, without location contours oftener than every hundred meters, in normal country with regular slopes. Some stretches, however, of badly complicated topography required locating the contours at every 20-m. station. When the slopes permitted, contours were drawn at 2-m. intervals, but much of the line permitted the showing of 10-m. contours only, at the scale employed.

The survey line was inked in red before the topography went on, and all contours and streams were inked before location was begun. The projection was made according to the method described in the late A. M. Wellington's classic work on the "Economic Theory and Practice of Railroad Location." This method consists of drawing in the grade contour, for the grade as predetermined or suggested by the country, and approximately run by the transit line, and of fitting this grade contour as nearly as possible within the limitations of acceptable alignment.

A profile was then taken off on Plate A paper, at scale of ¼ in. to 20 m. horizontally, and ¼ in. to 2 m. vertically. Decision was then reached as to the means of crossing all openings, and estimates of all material were made.

A general map at a scale of 1:500,000 was made to show the general routes, from which the map accompanying this article was sketched.

Pasto - Tumaco Location — Little previous work had ever been done in this section of Colombia, no railroad route from Pasto to Tumaco had ever been considered, and available maps and information were unreliable.

The general features of the location required reaching by one of the several river routes from Pasto the plateau of Tuquerres, which lies to the south of Pasto and extends roughly from the Sapuyes river to that bend in the Andean Cordillera which includes the peaks of Cumbal, Chiles, and Troya. Accordingly, leaving the point selected in the outskirts of Pasto, for yards and terminal, at an elevation of 2,590 meters, the location proceeds 17 kilometers upstream in the valley of the river Pasto, and employing the slopes of the western cordillera, reaches the pass known as the Cruz de Amarillo, at an elevation of 3,172 meters. This pass affords access to the watershed of the river Bobo, which is followed down to its junction with the river Guaitara, where the line crosses the latter stream at an elevation of 1,797 meters, 300 meters above the level of the water, which is here sharply enclosed in a vertical box canyon. The crossing selected is the same as that chosen by Doctor Uribe for the Pasto highway. It requires the only steel bridge in this location with but 36 m. of span, and also affords a passage for the highway. The Guaitara bridge is 50 km. from Pasto by the railroad location, and grades up to 4½ per cent compensated are employed to this point. The Guaitara canyon is followed upstream to the mouth of the Sapuyes river, and the valley of that stream and of the small creek, Los Molinos, takes the location to the important town of Tuquerres, 82.5 km. from Pasto, at an elevation of 3,040 m.

From this point the country dictated crossing the Tuquerres plateau, rising at its edge to the best pass between the Sapuyes drainage and the watershed of those rivers flowing directly westward to the Pacific. For this purpose the pass of Chimingual, 106.5 km. from Pasto, was selected. This lies at an elevation of 3,226 meters, the highest point touched by any of the surveys on this work, and is reached by 4 per cent compensated grades.

From this point, the only remaining problem was to reach the coast by the most favorable and direct route and as the pass of Chimingual suggests the use of the valley of the Guabo river, a precipitous descent of 1,200 meters is made at Chambu, the most favorable place for the necessary development, 27 km. in length but so spiralling as to cover but 11 km. in horizontal distance. At one point near the top of this development the line appears below seven times in a horizontal distance of 3.5 km. and a vertical drop of 627 m. The length of this part of the spiral is 16 km. and here are required the only tunnels on the route, one 170 m. long and one 360 m. long. Once in the valley of the Guabo River—also known as the Calera, and farther downstream as the Guiza—the route continues downstream to a point where the river boxes up in a vertical canyon, and the line climbs out to the valley of the Güelmambi. The grades from Chimingual to this point do not exceed 4½ per cent compensated. Soon catching the divide between the Mira and Rosario rivers, the location proceeds by its crest to avoid crossing the tributary small streams on each side of the ridge. The fact that the topography here is that of the Pacific coastal plain makes the use of this ridge acceptable, and preferable to the bottom of the valleys. This divide is followed as far as a point opposite Tumaco called El Pindo, where the crossing of a narrow estuary gives access to the island on which that city is located, 313 km. from Pasto, and 4 m. above sea level. The last 130 km. of this line are all below the elevation of 1,000 m., and no grade is greater than 3 per cent compensated.

No grade on this location was permitted to exceed 4½ per cent compensated. This was one of the predetermined limitations of the contract, as was also the alignment limitation to curves of not less than 16 deg. metric, equivalent to about 6 deg. 6 min. English, which gives a radius of 71.85 m. The minimum of tangent between curves of opposite flexure was 40 m.

Pasto - Popayan Location — The situation north of Pasto had been scarcely more explored than that to the south, although a survey was made in 1893 by the late Colonel Shunk for the Pan-American Railway Corp., over the entire Andean range, including the cities of Pasto and Popayan. Urged, no doubt, by excellent reasons, Colonel Shunk located most of this line on the slopes of the central cordillera, which, for our purposes it seemed undesirable to follow, so the splendid data collected by that organization were unavailable for our use. From a point in the valley of the Patia River, Colonel Shunk's line somewhat follows this new location, which will be discussed later.

To reach the frontier, the Pasto-Popayan line employs that portion of the location previously discussed, from Pasto to Tuquerres, and a further branch of 34 km. southward on the Tuquerres plateau that is without technical difficulty.

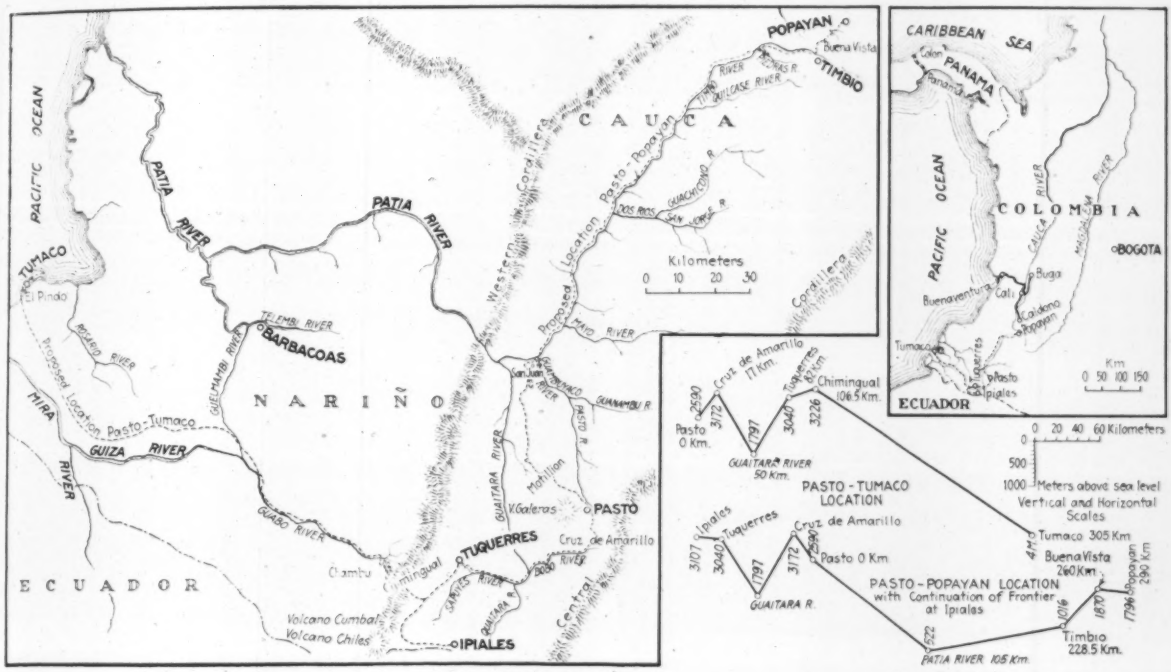
North from Pasto the first problem of the location was to reach the long basin of the Patia River, reconnaissance showing this route to be much less expensive and only slightly longer than the location in the slopes of the cordillera, made by Colonel Shunk. For the purpose of reaching the Patia River, however, this project was not so fortunate as the other, the only available basin, that of the Pasto River, turning out on reconnaissance to be disappointingly full of vertical canyons. The line leaves Pasto from the same point chosen on the Tumaco survey for yards and terminal, and follows the valley of the Pasto until its precipitous banks require the use of the slopes of the divide between the Pasto and Guaitara valleys. By these it attains the pass

of Motillon, whence the projection follows the right slope of a spur from the central cordillera to the pass of San Juan. There the route takes the left bank of the Patia River to the junction of the Guambuyaco River with the Patia. At this point the distance of 91 km. from Pasto proved to have been insufficient, at the rate of grade imposed, the line being at an elevation of 740 m., and the river more than 200 m. below. For this reason the line was run up the Guambuyaco canyon for a distance of 7 km. to catch the level of that stream, at 596 m. above sea level, and returns by the northern bank to the Patia River.

Here the second portion of this location is encountered, that of following the Patia valley as far as its grade might permit, the direction of that stream being conveniently northward with a slight eastward component. The right bank was chosen, to avoid the wide crossings of the rivers Mayo, San Jorge, Guachicono and Quilcase and for the advantage of better topography in other respects.

The crossing of the Patia was effected at Km. 105 from Pasto, at an elevation of 522 m. above sea level, the lowest point in both these projects, except for the termination of the Tumaco line at the coast. The valley of the Patia afforded an excellent route as far as the junction of the Quilcase and Timbio rivers, which form the Patia at that point. Here Colonel Shunk, who had maintained his location far to the east and above us, on the other side of the Patia, dropped to the banks of the stream, and rejecting the Quilcase valley, as we did, because of its more circuitous route and deep upper valley, assumed that the Timbio would carry his grades throughout. He took up his survey on the upper banks of the river above the town of Timbio, on the slopes of the central cordillera again. This assumption, however, is not justified, for although the upper valley of the Timbio near the town of the same name, is flat, and the lower portion carried our limiting grade of 3.5 per cent compensated for 40 km. upstream from the mouth, the river grade between these flatter stretches stiffens to 10 per cent. It was necessary therefore, to cross the Timbio at an elevation of 1,016 m. 228.5 km. from Pasto, and to employ the valley of the river Piedras, on the other side, for development, this being the only stream within reach that was not too steep.

At this point the next characteristic of this location became evident, that of leaving the friendly valleys of the Patia, Timbio and Piedras that had carried the line most satisfactorily for 150 km., to cross the continental divide to Popayan. Running up the Piedras for 4.5 km. and crossing at 1,120 m. above sea level, to continue rising on the northern side, with the maximum grade, found the line sufficiently high to ride out of the Timbio valley, cross that river again near the town of Timbio, and cross the continental divide at the pass of Buena Vista, with an elevation of 1,870 m., the highest point on this location since leaving the corresponding elevation in the first descent from Pasto.



MAP OF SOUTHERN COLOMBIA SHOWING THE LOCATION OF PROPOSED RAILWAYS

From this pass the final requirement of this location was solved by running toward the city of Popayan in the most direct route, crossing three small rivers near their sources at right angles, to arrive at Popayan, 290 km. from Pasto, and 1,796 m. above sea level.

The entire 290 km. from Pasto was located with no greater grade than 3.5 per cent compensated, the contract requiring this limitation as well as that of 16 deg. metric curves for a minimum. These are equivalent to about 6 deg. .06 min. English, and have a radius of 71.85 m. The minimum tangent between curves of opposite flexure was 40 m., and the rugged nature of the topography traversed is demonstrated by the fact that the line was 49.3 per cent curve, employing 69,000 degrees of central angle, and leaving 147 km. of tangent. The line had 50 km. of level grade, 130 km. of plus grade toward Popayan, to rise 1,900 m., and 110 km. of negative grade, to fall 2,700 m.

Fire Destroys Old Wooden Bridge

By Charles A. Mead

Chief Engineer, Bridges and Grade Crossings, New Jersey Public Utility Commission, Newark

FIRE started by lightning on the night of Sunday, July 22, destroyed a very old wooden bridge over the Delaware River at Stockton, N. J. Because of the great age of the structure as well as the nature of its destruction the following notes on it may be of interest.

Records show that the bridge was originally erected in 1812-13. This would make it 110 years old if it was not rebuilt at a later date; there is no record of such rebuilding. No information can be found as to the name of the builder or other pertinent facts.

Since 1911, when the writer first saw the bridge, only such repairs have been made as were necessary to keep it in service. In recent years it has been limited to loads of one ton. A year ago a Packard truck having a nominal capacity of 3½ tons, carrying a load of miscellaneous groceries, attempted to cross the bridge from the Pennsylvania end. It reached the second span from the New Jersey end, where it broke through the floor and fell into the river—a direct consequence of the driver's failure to heed the load-limiting signs. Many of the floorbeams over which the truck had passed were found broken. Repairs were made and the bridge was again opened to traffic under the one-ton limitation.

The drawings reproduced in Fig. 1 herewith show the principal features of the construction of the bridge, as plotted from a survey made in 1914. The spacing of the piers that supported the six river spans was quite irregular. Most of the old timber in the bridge was hemlock. The masonry was random. It is believed that the piers were probably founded on timber grillage and the abutments on rock. The truss intersections were held together with hand-shaved oak treenails 1⅝ in. in diameter.

The fire, which resulted from a lightning stroke on July 22, burned up five of the spans. The New Jersey end span was dragged from its abutment when the adjoining span collapsed; this was due to the continuous truss construction. A number of men who were fighting the fire fell with the span, some being injured. The stonework of the piers was spalled off by the heat 1 or 2 in. deep, and the tops were injured.

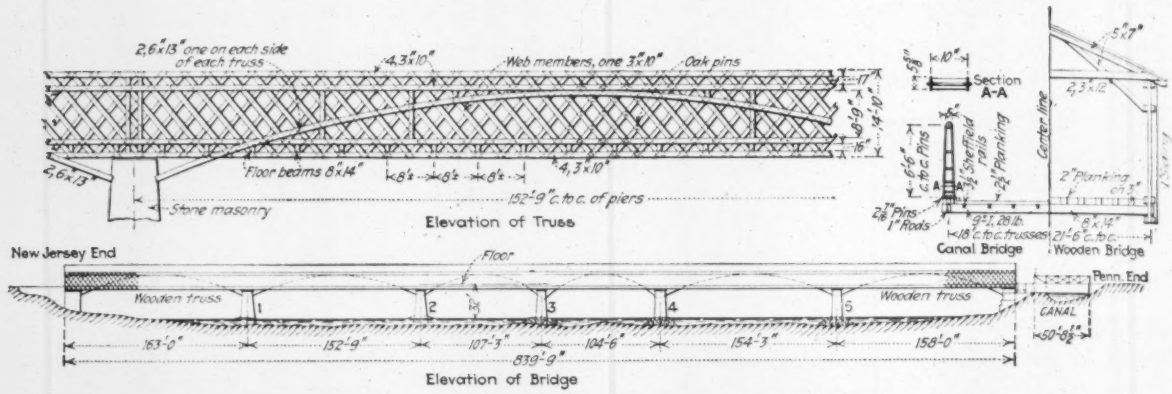


FIG. 1—CHARACTERISTICS OF TIMBER SPANS AND IRON APPROACH SPAN OVER PENNSYLVANIA CANAL

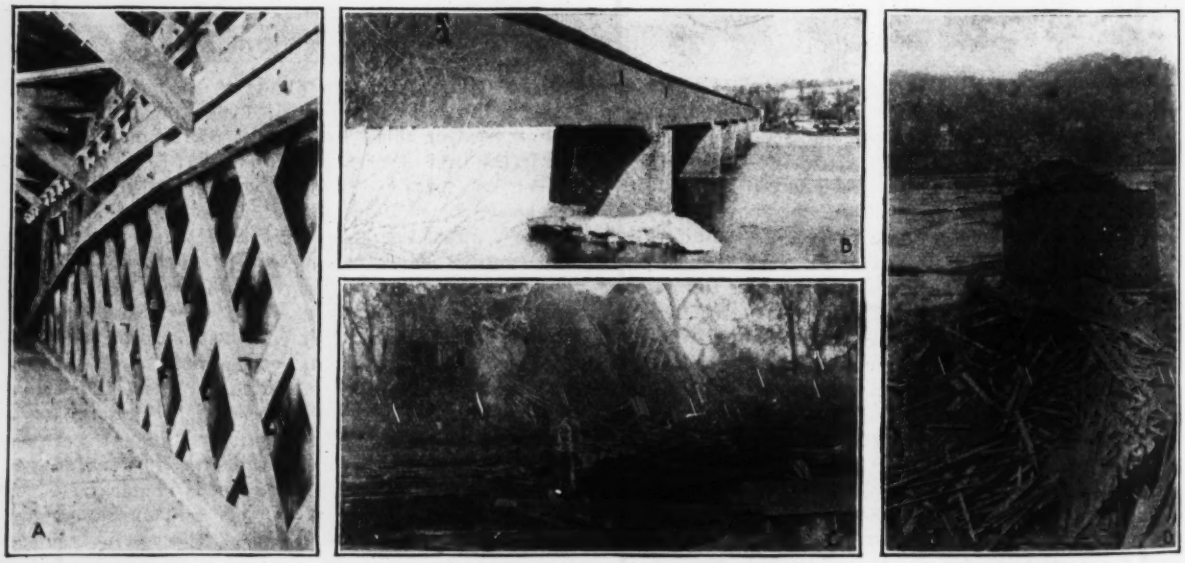


FIG. 2—STOCKTON BRIDGE, BEFORE AND AFTER THE FIRE

A—Interior view showing one of the trusses. B—General view of the bridge. C—Wreckage of the New Jersey Shore span. D—Ruins of the river piers.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Mechanics of the Human Body

REVIEWED BY GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

LE MOTEUR HUMAIN et les Bases Scientifiques du Travail Professionel—Par Jules Amar, Directeur du Laboratoire de Recherches sur le Travail Professionel au Conservatoire National des Arts et Métiers, Docteur des Sciences, Membre Correspondant de L'Academie des Sciences de Lisbonne; avec une Preface de Henry Le Chatelier, Membre de L'Institut, Inspecteur General des Mines, Professeur a la Sorbonne. 2nd Edition. Paris: Dunod. Cloth; 5x7 in.; pp. 690; 324 line cuts and halftones.

This is an interesting discussion of the human body from a mechanical standpoint. It treats of anatomy and human energy. It describes many sorts of experiments in the physiological laboratory and the application of mechanical principles to human labor. Compared with other motors, a laboring man is rated as having about one-seventh horse-power and an efficiency of 30 per cent. These figures mean little because they are apparently based on laboratory experiments of short duration, do not take into account cumulative fatigue, fatigue of particular muscles, mental fatigue, and other factors which are matters of importance.

Nevertheless, the book is an interesting one as showing the care with which the human mechanism is now being studied by physiologists.

River and Harbor Engineering

THE HYDRAULIC PRINCIPLES GOVERNING RIVER AND HARBOR CONSTRUCTION—By Curtis McD. Townsend, Colonel, United States Army (Retired), M. Am. Soc. C. E., Late President Mississippi River Commission. (Engineering Science Series.) New York: The Macmillan Co. Cloth; 6x9 in.; pp. 189; 5 line cuts. $2.60.

The literature in English of river and harbor hydraulics is limited to a very few books and to the proceedings of the technical societies, periodical literature and the report of the Corps of Engineers of the United States Army. Colonel Townsend has therefore done excellent service in setting down the results of his forty years of experience in this kind of engineering work. No one in the United States certainly is better qualified to write on the subject than he.

The book is devoted more largely to rivers than it is to harbors. It traces the geologic and hydrologic history of rivers, outlines the laws governing the flow of water in open channels, analyzes the question of sediment flow and describes methods of flood prediction. All this is the hydrologic side of the river and is not concerned with man's control of it. The next division is on the control. Here the methods of regulation are described in some detail under the heads of Bank Construction and Bank Protection, Improvement by Canalization and Dredging. Three chapters take up the question of flood and navigation control, particularly as relating to the Mississippi River, and repeat Colonel Townsend's well-known views regarding the proper method of control of the Mississippi. There is, moreover, an extended historical-descriptive chapter on flood protection in the various rivers of the world. A chapter on harbors, estuaries, and the mouths of rivers and harbors is followed by a final chapter on the economics of water transportation which is so definite and concise that it would be well if it were circulated to be read by all of the violent enthusiasts of waterways versus railroads. Colonel Townsend is by no means an antagonist of river transportation, but he sees and sets down clearly the conditions which govern such a development.

River regulation is a fascinating branch of engineering which few engineers outside of those in government service have occasion to practice. Moreover, it is a science in which experience counts more than theory. Any engineer, therefore, who has such work to do would do well to fortify himself with the record of experience here set down and thereby add to his own theory.

A.I.A. Promotes Appreciation of the Arts

THE SIGNIFICANCE OF THE FINE ARTS—Published Under the Direction of the Committee on Education of the American Institute of Architects. Boston: Marshall Jones Co. Cloth; 6x9 in.; pp. 481; 128 halftone plates. $3.50; or edition de luxe, $7.50.

To those engineers who ask themselves, What is art? and who wish for a concrete rather than an abstract answer this book should be welcome. It should be all the more welcome because architecture, with which the engineer has so much to do, takes up the larger part of the volume—the book was planned by a committee of the American Institute of Architects.

The specific object of the book is to arouse general "interest in the fine arts" and to create "a better understanding and appreciation of them." Particular attention is given to showing the relation of art to life, historically and today, and, more specifically, how the variations in the arts, and how the different styles of architecture, reflect, and were "developed from, the customs, habits and social and religious life of the several peoples."

By periods, architecture is distributed as follows: Introduction, George C. Nimmons, for the Committee on Education, A. I. A.; Classical, H. Howard Walker, Boston; Middle Ages, Ralph Adams Cram, Boston; Renaissance, H. Van Buren Magonigle, New York; Modern, Paul P. Cret, Philadelphia. A point of importance to engineers is the statement by Mr. Nimmons, that emphasis is placed on "those *vital principles of design and construction* [italics ours] which not only govern all good architecture, but should also influence the character of all other arts and every manufactured product and material thing that human hands can make." The chapter on Modern Architecture, Mr. Nimmons well says, "describes new methods of construction, the new problems of design, the revolutionizing of many old modes of life by the new era of mechanical development, and the interesting reflection of the very pronounced characteristics of the people of today in their buildings."

The Allied Arts are necessarily treated more briefly, but fully enough to give their main significance to the

engineer—and it is to be noted that a hope of more detailed treatment of these subjects later on is expressed. The six topics in Part II are: Sculpture, by Lorado Taft; Painting, Bryson Burroughs; Landscape Design, F. L. Olmsted; City Planning, Edward H. Bennett; Industrial Arts, Huger Elliott; Music, T. W. Surette. Messrs. Olmsted and Bennett are well known to many engineers as experienced practitioners in the two fields which they have reviewed, Mr. Bennett having been associated with the late D. H. Burnham, architect and city planner, and Mr. Olmsted having been long established in both landscape and city planning work.

Well chosen illustrations abound in the various sections of the book and each has a well selected bibliography which will enable the reader to pursue the subject as much farther as he may wish. Altogether the book is a commendable one and should do much to extend the knowledge and appreciation of architecture, the other fine arts and the industrial arts.

Two Notable Books on Town Planning

TOWNS AND TOWN PLANNING, ANCIENT AND MODERN—By T. Harold Hughes, Fellow of the Surveyor's Institution, Associate of the Royal Institute of British Architects, and E. A. G. Lamborn, Hon. M. A. Oxon. New York: Oxford University Press, American Branch. Boards, cloth back; 8x10 in.; pp. 156; colored frontispiece, folding map and 89 line cuts and halftones. $5.

SITE PLANNING IN PRACTICE: An Investigation of the Principles of Housing Estate Development — By F. Longstreth Thompson, B.Sc. (Eng., London), Assoc. M. Inst. C. E., Late Assistant Architect to the Housing Department, Ministry of Health; with a Foreword by Raymond Unwin, F.R.I.B.A., Chief Architect, Housing Department, Ministry of Health. London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. 16s.; $5,35.

Engineers, architects, and students who are taking up city planning for the first time, or who wish to enlarge or freshen their knowledge of the historic backgrounds of the art and the way it has been influenced by the habits, customs, and spirit of the different periods of history, will find "Towns and Town Planning, Ancient and Modern" useful, interesting, and suggestive. The book surveys town planning the world over from the earliest known examples of ancient times to the present day.

From the book one may learn, either by direct statement or deduction, how largely military considerations governed town planning to and through the Middle Ages; how the ending of the need for walled towns led to a change from vertical to horizontal expansion as populations increased; how a desire to increase land rents encouraged monks and kings to expand town areas by turning agriculture into urban areas, at the same time making villeins and serfs free citizens, through grants in many of the mediaeval borough and city charters; how the "industrial revolution" created city barracks and slums in the prevention or amelioration of which neither the industrial nor spiritual lords of the day took thought, except to oppose—the first having no interest except in factory profits, and the second feeling more concern for proprietors than for people, and for rents from overcrowded, insanitary dwellings than for reforms of any kind; and how in the long process of time it finally was realized that cities exist for the people rather than for emperors and kings, or military, industrial, or religious overlords.

Of all the kingly and military figures chronicled in this history of town planning, Edward I stands out most prominently through the towns he caused to be planned and built in his French, English, and Welsh domains. Louis XIV and Leñôtre at Versailles, Washington and L'Enfant at Washington, Napoleon III and Baron Haussman at Paris, Howard in his visions of the Garden City, and Cadbury and Lever and others in making the vision a reality, and Burnham in his Chicago plan are some of the notable figures since Edward I that appear in this inspiring survey of town planning. In the field of legislation, Sweden as early as 1734 and in more detail in 1874, stands out. Germany took a place of its own, both in theory and practice, soon after Sweden's example. Other high spots are the British Town Planning Act of 1909, due largely to John Burns and Lloyd George (although the former is given no credit in this book) and recent French legislation. Although the book mentions the recent sweep of town planning in America it takes no account of the large volume of state legislation which has given town planning and zoning a legal status here. Nor does it take into account vertical city expansion in America made possible by steel and steel-concrete construction and the high-speed elevator, with the serious problems in city planning thus created.

"Site Planning in Practice," by the London partner of Thomas Adams, is a book of quite a different sort from the one we have been considering, but in a sense it supplements the final chapter of "Towns and Town Planning," which is devoted to current and future town planning. Primarily, the second book is devoted to that part of housing which plans street, block and house-group layouts; but this also includes a consideration, mostly sketchy, of water supply, sewerage and sewage disposal, schools and other public buildings, parks, open places, and main highways. Transportation is even more lightly sketched, to which no serious objection can be made in view of the main topic of the book, but if water supply and sewerage are to be included, why not gas and electric lighting?

The greatest usefulness of the second book lies in its analysis, by text and diagram, and with halftone illustrations where feasible, of the economics, hygienics (light and air) and in less degree the esthetics, of placing houses upon land and providing access to and from them. The facts, figures and illustrations on this main topic will repay study by American town planners, even though some of the governing conditions in England are so different from those in America.

It should be understood that the volume has a still further limitation in that it is confined almost wholly to what may be termed liberal-housing developments under a two-story height limit. That is, the authors base their detailed studies on the new British housing limits of twelve families to the acre (or sixteen houses if 25 per cent is allowed for streets and open spaces). This is liberal compared either with previous two-story house practice in England or with American multi-story tenement and apartment houses.

The attention that the author seems compelled to give to utilizing almost every foot of frontage, even to the extent of almost or quite continuous front walls, is distressing unless one remembers that this twelve-family limit gives every family a fairly deep though narrow front or back yard (considered sufficient to produce an ample supply of vegetables) and until it is realized that the real cost of housing includes all the attendant outlay for: (1) Land, including (a) the house lot and (b) streets and open spaces, and (2) Pavements, curbs, sidewalks, house walks, water and

gas mains, sewers, wires for electric and telephone service. As to how these various elements affect cost, Mr. Thompson takes into account, in his view cost figures, only land, road and sewer construction. Presumably he leaves the cost-elements of the other utilities to be covered in the charges for water, gas, electricity and telephones; or even assumes that in most cases the householders will do without telephones and in many without electricity—neither of which would be expected in most American twelve-family-per-acre new housing developments.

The author gives no evidence of having consulted "Industrial Housing" by Morris Knowles (see these columns, Oct. 21, 1920, p. 807), in which the economics of housing developments, including land, street and utility cost elements, is worked out in detail and numerous examples of site planning are given.

Notwithstanding the usual limitations of a book written chiefly for use in a single country (which applies more particularly to Mr. Thompson's Site Planning) both these volumes deserve wide attention in this country; particularly should they be given immediate place in the libraries of town planning engineers, planning commissions, colleges and municipalities.

Ups and Downs of Business and Labor

BUSINESS CYCLES AND UNEMPLOYMENT Reports and Recommendations of a Committee of the President's Conference on Unemployment, Including an Investigation Made Under the Auspices of the National Bureau of Economic Research. With a Foreword by Herbert Hoover. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 405; diagrams. $4.

Growing out of the work of the President's conference on unemployment, which met in Washington in September, 1921, this report presents the results of an exhaustive investigation together with certain practical and constructive suggestions designed to stabilize business and industry so as to prevent the waste and suffering now brought about by the valleys in the so-called business cycle.

Although the immediate problem of the committee was to cope with the situation then existing, it was recognized that when business depression has come it is too late for any measures except those of relief for the unemployed, and that, if we are to follow a policy of prevention rather than of mitigation, it will be necessary to develop the exercise of foresight and to provide means to maintain greater business stability.

As a result of its studies the committee is confident that the destructive extremes of business cycles can in a large measure be controlled.

In undertaking its study, however, it found that little could be accomplished toward a definite constructive program until the fundamental facts upon which action must be based are made available in current and comparable form. A considerable part of its recommendation concerns means whereby data may be accumulated.

The general methods by which the business cycle may be controlled are outlined by the committee as (1) control of credit expansion by banks generally, (2) possible control of inflation by the Federal Reserve System, (3) control by individual business men of the expansion of their own industries, (4) control of public and private construction, including construction by public utilities at or near the peak of the business cycle, (5) construction of public works in the depression, (6) unemployment reserve fund, (7) federal and state employment bureaus.

Upon these general principles, that is, the need for facts and methods of control, the committee makes ten recommendations. It sets forth also six questions for discussion, addressed respectively to business men, to bankers, to managers of public utilities and public service commissions, to wage earners, to engineers and to citizens' organizations, designed to procure from each its contribution toward the solution of the problem.

Following the formal report of the committee, the greater part of the book is given up to a series of papers discussing the relation of business cycles to unemployment and proposed remedies for present conditions. These have been prepared by authorities in the several fields of economics and social science, and include the following:

Business Cycles, by Wesley C. Mitchell, National Bureau of Economic Research; Individual Industries and Enterprises in the Business Cycle, Frederick R. Macaulay, National Bureau of Economic Research; Economic Losses Caused by Business Cycles, Wesley C. Mitchell and Willford I. King, National Bureau of Economic Research; What the Present Statistics of Employment Show, William A. Berridge, Brown University; Under-Employment, Paul F. Brissenden, Columbia University; Changes in Employment in the Principal Industrial Fields, Jan. 1, 1920, to March 31, 1922, Willford I. King, National Bureau of Economic Research; Effect of Unemployment Upon the Worker and His Family, Stuart A. Rice, Columbia University;

The Various Kinds of Remedies Proposed, by Wesley C. Mitchell, National Bureau of Economic Research; Methods of Stabilizing Production and Distribution, Sanford E. Thompson, The Thompson & Lichtner Co., Engineers, Boston; Problem of "Cancellation," Gilbert H. Montague of the New York Bar; Methods of Stabilizing Work in the Building Industries, Ernest S. Bradford, vice-president of the American Statistical Association; Stability of Railway Operations, Julius H. Parmelee, Director of the Bureau of Railway Economics; Long-range Planning of Public Works, Otto T. Mallery, Member Pennsylvania State Industrial Board; Financial Devices for Controlling or Mitigating the Severity of Business Cycles, Thomas Sewall Adams, Yale University; Public Employment Offices and Unemployment, Shelby M. Harrison, Director of Department of Surveys and Exhibits, Russell Sage Foundation; Trade Union Out-of-work Benefits, John B. Andrews, Secretary of the American Association for Labor Legislation; Unemployment Insurance, Leo Wolman, New School for Social Research; Charting the Course of Employment, Mary Van Kleeck, Director of the Department of Industrial Studies, Russell Sage Foundation; Statistical Indexes of Business Conditions and Their Uses, Oswald W. Knauth, National Bureau of Economic Research; Various Devices used for Stabilizing Business, by a Committee of the Federated American Engineering Societies.

These papers are effectively supplemented by tabular and graphical matter and constitute a unique compendium of data concerning the many factors that enter into modern social and economical development.

United States Bureau of Public Roads

THE BUREAU OF PUBLIC ROADS, Its History, Activity and Organization—By W. Stull Holt. Service Monograph of the United States Government, No. 26. Baltimore, Md.: Johns Hopkins Press. Cloth; 6x9 in.; pp. 123. $1.

In the last few years the work of the Bureau of Public Roads has grown so much and its influence on highway development has become so great as to make it desirable for engineers and others to have a handy volume like this one to which they can turn for information. Between its covers answers may be found to most inquiries likely to be made concerning organization, practices, laws and finances. The Federal Aid Acts are reprinted.

PUBLICATIONS RECEIVED

THE ENGINEERING ASSOCIATION OF MALAY, organized in 1920, published creditable *Transactions* a few months ago and announces that a similar volume for 1922-23 is now ready. The 1920-21 volume contains five papers, with folding plates, on Malayan water-supply works, railways and wharves, and a paper on Deterioration of Structures in Sea Water. Four of the papers are by members and associate members of the Institution of Civil Engineers and one is by an Assoc. M. Inst. Mech. E. (Serembam, Federated Malay States: F. M. Corkill, honorary secretary).

THE MILWAUKEE ACTIVATED-SLUDGE PLANT is briefly described in a pamphlet issued by the Sewerage Commission of Milwaukee, Wis.

SIX PAPERS ON SEWAGE TREATMENT and one on sewerage maintenance are included in the *Proceedings* of the New Jersey Sewage Works Association for the two years 1922 and 1923. Work at the sewage experiment sub-station at New Brunswick, N. J., is the subject of two papers. John R. Downes, of the Plainfield joint sewage-works, discusses odors. A report of a talk on Superfluous Sewage Treatment Works, by M. N. Baker, associate editor *Engineering News-Record*, includes a summary of attempts to treat sewage by electrolysis and comments on the plans to treat the sewage of Trenton by the direct-oxidation process, with particular reference to the Hirst-Potts charges, which had been filed with Governor Silzer shortly before the 1923 meeting of the association. (Myron E. Fuller, secretary-treasurer, 36 Mt. Airy Ave., Philadelphia, Pa.; $1.)

SYSTEMATIC ANTI-MALARIA WORK through the control of mosquito breeding has now been carried on in South Carolina since 1919 under a tripartite agreement between the U. S. Public Health Service, the International Health Board and the South Carolina State Board of Health. An illustrated pamphlet reviewing the work, written by L. M. Fisher, associate sanitary engineer, U. S. P. H. S., may be obtained on request from the State Health Officer, Columbia, S. C.

NOVEL EXPERIMENTS designed to lead up to the design of an intensity rain gage, apparently for use where heavy rainfalls occur, are described in a paper on The Experimental Development of an Automatic Integrating "Intensity" Rain-Gage Without Clockwork, by John W. Meares, C. I. E., M. Inst. C. E. The principle utilized was that the horizontal trajectory of water discharged from a small jet connected with the funnel tube of a rain gage would vary with the head in the gage, which in turn would depend on the intensity of the rainfall. Having determined these trajectories for various intensities, receptacles are located accordingly and, presumably, the depths or volumes caught in each receptacle are measured and a record made in terms of intensities. The author retired from the British Indian Service before his studies had been completed to his satisfaction, but states that installation of the apparatus on a working scale in India is under way; also that he has refrained from taking out patents. (London: Institution of Civil Engineers; Selected Engineering Papers, 1923, No. 2.)

"COMMERCIAL PREPAREDNESS" and "Greater Prosperity Through Greater Foreign Trade" are slogans that appear on the cover and title page of the proceedings of the Tenth National Foreign Trade Convention, held at New Orleans in May of this year. (India House, Hanover Square, New York City.)

THE WATER-POWER SITUATION IN NORTH CAROLINA is outlined in circular No. 6 of the water resources division of the North Carolina Geological and Economic Survey. Besides supplementing and bringing to date similar information given in Circular No. 2 this one enumerates the factors which are tending toward drawing on sources for power supply outside the state.

ENGINEERS OF HIGHWAY DESIGN WILL find suggestive information in the pamphlet of 48 pp. on economics of highway grades, published by the Engineering Experiment Station of Iowa State College, Ames, Ia. From experiments made in 1919, Prof. T. R. Agg arrives at certain tentative conclusions respecting allowable expenditure for reducing highway grades.

THE MINISTER OF PUBLIC WORKS OF ITALY through the Council of Public Waters (Consiglio Superiore Delle Acque Publiche, Rome, Italy) issues in the form of "annali" excellent reviews of water-works practice in Italy. The latest one, Vol. 5 of 1923, second section, has some beautiful views of the Tirso Dam, the highest multiple-arch dam in the world, recently described in *Engineering News-Record;* articles on rock tunnels, design of multiple arches and hydro-electric developments in Italy. The work is under the charge of the eminent Italian engineer, Carlo Bonomi.

NO ONE VOLUME contains more valuable current data on concrete and reinforced concrete than the Proceedings of the American Concrete Institute. Volume 19 of that society, giving the *Proceedings* of the nineteenth annual convention, is now available through the secretary, Harvey Whipple, Friesma Building, Detroit, Mich. It contains in addition to the numerous committee reports of the society a number of well illustrated papers in all fields of concrete design and construction.

New Books and Revised Editions

LE CALCUL RATIONNEL DES ÉLÉMENTS D'UNE CONDUITE FORCÉE EN MÉTAL: Sur base de la Théorie de Sau Rendement Economique Maximum—Par Paul P.-Santo Rini, Ingénieur E.P.Z., Ingénieur en Chef de la "Societe Anonyme d'Etudes et d'Enterprises," Athens. Grenoble, France: J. Rey. Paper; 6x9 in.; pp. 39; line cuts.
A new printing of a study first published in 1921.

THE DEESIDE REGIONAL PLANNING SCHEME [Chester & Flintshire]: Report Prepared for the Joint Committee of Local Authorities by Patrick Abercrombie, Sydney Kelley and Theodore Fyfe. Liverpool: University Press. London: Hodder & Stoughton. Paper; 10x12 in.; pp. 67; halftone plates and folding maps, some of the latter large and in colors. 7½s. net.
Follows the same general line as the Doncaster report noted at length in these columns July 19, p. 110, but is of far more general interest because Chester and Flint afford remarkable examples of Roman and mediaeval town planning, while Chester has a notable cathedral and the ruins of Flint and Hawarden Castles, as well as other ruins, to add to the attractions of the region considered in the planning scheme. Flint, the report says, was "laid out by Edward I, in 1277, as an appendage to his mighty castle and has preserved its mediaeval plan almost intact." Edward I, it may be added, was one of the greatest town planners the world has known.

ESTIMATING BUILDING COSTS—By Charles F. Dingman, M. Am. Soc. C. E., M. Am. Soc. M. E., M. N. J. Soc. A. New York and London: McGraw-Hill Book Co. Flexible cloth; 4x7 in.; pp. 240. $2.50.

GERMANY'S CAPACITY TO PAY: A Study of the Reparation Problem—By Harold G. Moulton and Constantine E. McGuire, with the Aid of the Council and Staff of the Institute of Economics. New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 384; 7 line cuts. $2.

HÜTTE: DES INGENIEURS TASCHENBUCH—Herausgegeben vom Akademischen Verein Hütte, E. V. in Berlin. 24 auflage, II Band. Berlin: Wilhelm Ernst & Sohn. Flexible cloth; 6x8 in.; pp. 1288, illustrated. $2 in Germany.
This volume of the new (24th) edition of the well known Hütte deals, among other things, with steam boilers, steam turbines, metal working machines, ship design, propellors, etc., automobiles, and some phases of electrical engineering.

INDUSTRIAL AMERICA IN THE WORLD WAR: The Strategy Behind the Line, 1917-1918—By Grosvenor B. Clarkson. Late Director of the United States Council of National Defense, with an Introduction by Georges Clemenceau. Boston and New York: Houghton, Mifflin Co. Cloth; 6x9 in.; pp. XXIII +573; 25 halftone plates of individual and group portraits. $6.

INDUSTRIAL DEMOCRACY: A Plan for Its Achievement—By Glenn E. Plumb and William G. Roylance. New York: B. W. Huebsch, Inc. Cloth; 6x8 in.; pp. 359; frontispiece portrait of senior author. $2.

OIL FLOW-VISCOSITY AND HEAT TRANSFER: Including Crude and Fuel Oil Viscosity Temperature Charts, Pipe Line Temperature Drop Charts, Commercial Pipe Coefficient Chart, Pressure Loss in Fittings Chart, and Formula for Testing Oil Heaters, Coolers and Heat Interchangers—By R. S. Danforth, Assoc. Mem. Am. Soc. C. E. San Francisco, Calif.: The Author, 525 Market St. Thick paper, cloth back; 6x9 in.; pp. 16, besides plates; $2.

THE VENTILATION OF PUBLIC BUILDINGS—By Robert Boyle. London: Robert Boyle & Son. Boards; 6x8; pp. 50; line cuts. 6s.
Excerpts from (1) reports of Royal Commissions and Select Committees on Ventilation Appointed by the British Houses of Parliament and (2) from other sources, mostly British, favoring natural rather than mechanical ventilation. Most of the excerpts are undated. A one-sided publication, likely to mislead the uninformed.

TABELLEN UND DIAGRAMME FÜR WASSERDAMPF—Von Dr. Phil. Dr.-Ing. E. H. Osc. Knoblauch, Dipl.-Ing. E. Raisch, and Dipl.-Ing. H. Hausen. Munich and Berlin: R. Oldenbourgh. Paper; 8x10 in.; pp. 32; 3 folding diagrams. 50c.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Soil Tests Essential to Foundation Design

Sir—Having acted, in an advisory capacity, for the Westinghouse Co., in connection with the underpinning of the foundations for their new building in Philadelphia, the writer was glad to see the full description of this interesting work in your issue of August 2, 1923, p. 192.

The ingenious plan adopted by the contractors, and the thorough manner in which the work was carried out, reflect much credit on their engineering and business methods. It is perhaps worth while to add that the strength of the U-bars, by which the new needle beams are attached to the footing slabs, was fully tested by actual experiment in the field.

The principal lesson to be learned from this partial failure, is of course the need, in all cases, of making thorough soil tests, before deciding on the methods to be used in foundations. Very truly yours,

HENRY GOLDMARK,
Consulting Engineer.

New York City, Aug. 8, 1923.

Subways and Building Heights

Sir—In connection with the question of building heights mentioned in the editorial in your issue of July 12, what the cities are doing is described in the Chicago *Herald & Examiner* of July 16 as "Chasing Their Tails." I enclose copy of this editorial.

So far as light, ventilation, architecture and beauty are concerned, these considerations, important though they be, can be laid aside. The difficulty of transportation cannot be laid aside and I do not agree with you when you say that these difficulties have never been made argument in height limitation, but I do agree that they have not received the study which they should. It seems obvious and self-evident that there should be a proper relation between the width of streets serving buildings and the *intensity of occupation* of those buildings. A tall building to be served by a narrow street is as I see it a matter of plain stupidity.

Building subways is a tremendous burden, in one way or another, on a community and it does not solve the problem. It is, in fact, just one step in the process of chasing our own tails.

Chicago, Ill., July 17. B. F. AFFLECK,
President, Universal Portland Cement Co.

[The editorial from the *Herald & Examiner* is as follows:

"When a dog chases his tail we laugh at canine stupidity.

"But when a government announces, through its Navy Department, that an armor has been invented which no shell can pierce, and then follows it with a War Department proclamation of a shell no armor can stop, we call it progress.

"So it is economic progress when wages are raised because prices are high, and then high wages send prices higher, so the wages cannot catch up with it.

"The Kelker report on 'Unified Transportation' made to the Chicago city council recited the fact that in New York City recently a new subway line was built beneath a certain street. Within the year a single building in a single block was built so great in size that it immediately absorbed one-third of the capacity of the new subway.

"That is no reason we should not hasten the building of subways in Chicago. But it is possible that even through subways we shall not travel to the millennium."—EDITOR.]

Computing Motor-Vehicle Fees

Sir—With reference to Mr. Barnett's article on "A Logical Method of Computing Motor-Vehicle Fees," *Engineering News-Record*, May 3, 1923, p. 797, it is desirable at the outset to get the fundamental facts of the question clearly in mind. Mr. Barnett speaks of annual cost and first cost, giving annual cost as the sum of three items, Interest + Maintenance + Sinking Fund—which is correct, but includes first cost, it being assumed that interest and sinking fund is for retiring bonds issued for the improvement. Bonds should not, of course, be issued for maintenance. The writer also assumes that the motor-vehicle owner does not pay the complete first cost of the system. Naturally, the general public as a class, being an indirect beneficiary, should share to some extent in such cost, but not in costs of maintenance.

To start then, where Mr. Barnett does, and with the above in mind, annual cost is the sum of Interest + Maintenance + Sinking Fund Payment. Let us condense this into two items, (1) Maintenance + (2) Interest and Sinking Fund Charge. Now what is maintenance? It is that branch of highway service applied constantly to the system which makes good each defect and deterioration as it occurs, reconstructing where necessary, and in short keeping the improvement or system in the condition *equal* to that in which it was when constructed. Consequently improvements so maintained are permanent, and strictly speaking, wear-proof. The cost of maintenance is the cost of such service. The second item of cost relates to the cost of the original construction.

Now, then, the motor vehicle owner must be assessed for the service which renders the improvement wear-proof, after which he must also share in paying the cost of original construction. This being true, why, then, after the first mentioned service has been paid for, should he be further penalized for producing impact on a road which is already made immune to impact, and is wear-proof (because maintained)?

Where an improvement is provided for a community, its cost must be shared according to the capacity of each individual to utilize or enjoy such improvement, that is, provided it is equally free to their use and enjoyment. Damage to the improvement must be made good by the individual who actually commits the damage, and not by the community according to the capacity of each one to do such damage. Thus, we arrive at the conclusion: for interest and sinking fund payment, each vehicle must pay according to capacity to utilize the system; for maintenance, each vehicle must pay according to the damage it actually does. The sum of the payments makes up the total annual cost.

For all practical purposes the capacity of a vehicle to utilize the improvement varies as to load carried and the speed, for which the fee becomes,

$$\text{Fee} = C \times L \times S = \frac{C \times L \times HP}{W}$$

where C is a constant, L = load above springs, HP = horsepower, and W = total weight loaded. This gives as the fee of the three-ton truck a sum about 50 per cent in excess of the Ford touring car for its item.

So far as the damage done is concerned, Mr. Barnett's formula only gives capacity to produce impact and therefore damage, and hence is useless unless distance traveled is taken into account. There must also be considerable doubt as to the effect of resiliency of tires, and notwithstanding tests made by the Bureau of Public Roads resulting in a factor of 7 for the resiliency of a pneumatic tire relative to the solid tire, it certainly would seem more on the side of safety and conservatism to eliminate this factor for the present, until the actual facts have been demonstrated by more extended field test. Other factors such as applying of brakes, and shifting gears are items whose effect cannot well be calculated. Such uncertain factors are to a greater or less degree taken care of through such a tax as the gasoline tax. As all motorists know, the consumption of fuel is affected very appreciably by condition of tires, speed, shifting of gears, applying of brakes, etc.

While the writer does not believe that the total cost of

maintenance should be met by a gasoline tax, he does believe that between 50 and 75 per cent of it should be, and the balance should be met by a vehicle fee. For those using gasoline for purposes other than the propelling of motor vehicles on the roads, a system of rebates will, it is believed, be worked out.

With a gasoline tax, the items of cost to be met by a license fee become: (1) Maintenance-Gas Tax + (2) Interest and Sinking Fund. The first is met by Mr. Barnett's formula for fee, the second by the one above given, and the sum of the two is the license fee. The constant in the formula should in each case be worked out by assuming an arbitrary value as the fee for a particular car, and then adjusting to give the result desired for the total. The average, as taken by Mr. Barnett, might not be a point on the curve, unless average weight, horsepower, etc., were carefully worked out, which would be laborious and involve useless effort.

Taking Mr. Barnett's figures and assuming that, of the $6,000,000 total, $4,000,000 is required annually for maintenance, of which latter $2,800,000 may be raised by a gasoline tax (given approximately by a 2c. tax on the basis of 350,000 cars) we then have, to be raised by Mr. Barnett's formula, $4,000,000 — $2,800,000 = $1,200,000 and the balance, $2,000,000, to be raised by the formula proposed by the writer, then assuming Mr. Barnett's figures for average values to be correct and neglecting resiliency,

C (in Barnett penalty formula) =

$$\frac{1{,}200{,}000 \times 3{,}000}{350{,}000 \times 1{,}600 \times 500 \times 30} = 0.000428 \text{ (approx.)}$$

C (in writer's formula) =

$$\frac{2{,}000{,}000 \times 3{,}000}{350{,}000 \times 1{,}600 \times 30} = 0.357 \text{ (approx.)}$$

For the Ford Touring Car:

$$\text{Penalty Fee} = \frac{0.000428 \times 1{,}450 \times 300 \times 25}{2{,}500} = \$1.87$$

$$\text{Utilization Fee} = \frac{0.357 \times 1{,}450 \times 25}{2{,}500} = \$5.17$$

Total License Fee = $7.04, say $7

For the 3-Ton Truck:

$$\text{Penalty Fee} = \frac{0.000428 \times 7{,}200 \times 1{,}200 \times 35}{12{,}000} = \$10.80$$

$$\text{Utilization Fee} = \frac{0.357 \times 7{,}200 \times 35}{12{,}000} = 7.50$$

Total $18.30, say $18.25

This compares with $8.50 and $49.30 respectively as given by the Barnett formula.

J. F. SEILER,
Engineer of Bridges, Wyoming State Highway Dept.
Cheyenne, Wyo.,
June 19, 1923.

[Copy of this letter was sent to Mr. Barnett for comment and his reply follows.—EDITOR.]

Sir—Mr. Seiler's comments on my article under the caption of "A Logical Method of Computing Motor-Vehicle Fees" are not without merit. It is admitted that no one form of tax will equitably meet all the requirements for a highway development program. It would be well, however, to confine our attention to one subject at a time and to leave for other and separate discussions such collateral issues as the distribution of construction costs between property owners and users of the road, or that of the gasoline tax sales, or whether maintenance should be defined so as to include replacement and reconstruction.

The underlying idea of my original article was that of distributing a given tax burden among motor vehicles in such a way that greater equity to the owners would be assured. The method there proposed applies equally well whether the fees are used solely for maintenance or for the entire annual cost of the road. Neither does this proposed method preclude the adoption of a gasoline sales tax in conjunction therewith.

The fact that motor traffic—through reduction of operating cost and in the saving of time—is the greatest beneficiary of, and is also the largest factor in, producing wear on roads, gives the best reason for collecting from such traffic, by means of license fees, the equivalent of a major portion of the annual costs. We start from the basis that a certain sum of money is to be raised by collecting motor license fees from motor vehicle owners. This sum may be sufficient to pay the entire annual costs or only some part thereof, such as maintenance. That is a matter of state policy and is beyond this discussion. The immediate problem is then so to distribute these fees among the motor vehicle owners that some fairness and equity may prevail.

If we take the use of the road as a basis for assessing fees on vehicles, we are confronted with the difficulty that we cannot determine in advance the amount of such usage. We should need to know not only the distance traveled, but also the load carried. Again if the mere use of the road were the test, then the vehicles that produce the same ton-mileage of transportation should be assessed equally. However, it is readily seen that if these vehicles are of different sizes and types some of them will produce more wear upon the roads than others and that it would then be necessary to devise some means of assessing against the more destructive vehicles a heavier penalty. The gasoline would, of course, afford some partial measure for the use of the road as such usage occurs. But a gasoline-sales tax is not a motor-vehicle tax and so must be left for separate discussion. We are here directly concerned with the proposition of assessing license fees against motor vehicles. The practicable basis, the basis that will give some approach to equity for such assessments, is the amount of wear or damage done the road by any vehicle.

The wear on the road is largely due to impact, which all vehicles produce to a greater or less extent. While it is not practicable to measure in advance the actual impact, or rather to measure the total of a series of such impacts as the vehicle moves over a stretch of the road, it is, however, entirely feasible to determine in advance the capacity of the vehicle for producing impact. It is thus seen that the practicable thing, the tangible thing that we can lay hold of, is the capacity of vehicles to produce impact. The license fees based upon such capacity will be a closer approximation to an equitable standard than anything we now have.

The determination of impact stresses must necessarily include the properties of the body absorbing the impact, as well as the amount of energy stored up in the motor vehicle springs which produces the impact. To leave out the factor of resiliency is to ignore the fundamental principles of mechanics underlying the phenomena of impact. Furthermore there is no reason at this time to discredit or minimize the results of the investigation carried on by the Bureau of Public Roads, for as yet we have no better information nor more reliable data upon which to base our conclusions.

Jefferson City, Mo., R. C. BARNETT.
July 2, 1923.

Swiss Rack-Rail and Cable Mountain Lines

Steep-grade mountain railways operated by rack-rail or cable, in Switzerland, aggregate 64 in number and about 98 miles in length, according to a paper in the *Proceedings* of the International Tramway and Light Railway Association by Charles Rochat, general manager of the Geneva Electric Tramway Co., Switzerland. Of 15 rack-rail lines aggregating 67.58 miles, 9 are operated by electricity, with a total of 41.54 miles. The first was the Righi Ry., 4.24 miles, opened in 1877. The latest were the Jungfrau Ry., 5.71 miles and the Villars-Bretaye Ry., 2.29 miles, opened in 1912 and 1913 respectively. The longest is the Wengern Alp Ry., 11.78 miles, opened in 1893. Cable incline railways are 49 in number, aggregating 30.38 miles. Of these 37 lines with 24.8 miles are operated by electricity. The first was the Lausanne-Ouchy line, 1.11 miles, opened in 1877, and the lates was the Trieb-Seelisberg line, only 0.7-mile, 1916. The longest of these cable inclines is the Sierra-Vermala line, 2.62 miles, opened in 1911.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

An Ordinance Zoning the city of Pittsburgh, Pa., was passed by the City Council on July 29 by a vote of 7 to 1, but at last reports awaited action by the mayor.

A Branch Line 30 Miles Long from near Forsyth, Montana south into the Rosebud County coal fields is being built by the Northern Pacific Ry. Co. to provide coal for its own use on the part of its system between Mandan, North Dakota and Missoula, Montana. A. T. Stevens is chief engineer.

Contracts for the Extension of the Toronto harbor works are in process of being awarded to Roger Miller and Co. of Toronto. The contract is for breakwater work, about 4,000 ft., in front of the exhibition grounds. The extended contract will involve a total outlay of slightly over $1,000,000.

Authorization Has Been Given the Oregon Short Line R.R. by the Interstate Commerce Commission to build a line from Rogerson, Idaho, to Wells, Nev., a distance of 97.7 miles, on the express condition that the construction will be commenced on or before Jan. 1, 1924, and completed on or before June 30, 1925. The cost is estimated at over $5,000,000.

Assurance That the Provincial Government would give its immediate attention to the question of the early completion of the Ottawa-Prescott highway was given by Premier G. Howard Ferguson of Ontario to a deputation which waited on him in Ottawa last week. The Prescott highway is important principally because it is an international highway giving access to the United States.

About $20,000,000 is Being Expended and about 2,000 men are employed on work designed to enlarge and improve the grain transhipping facilities of Fort William and Port Arthur, Ont., in time for the expected bumper crops this year. The storage capacity of the two ports will be increased nearly 10,000,000 bu. by new construction, and a proportionate increase will be made in the handling capacity of the port.

Application Has Been Made by the American Niagara Railroad Corp. to the Interstate Commerce Commission for authority to construct a road from Tonawanda Junction, on the New York Central, to connect with the Canadian Niagara Bridge Co.'s line at the international boundary over the Niagara River, a total of 10.4 miles of track. This new line will furnish connections to the T. H. & B., the C. P. R., and the M. C. R.R., as a new outlet for freight from this territory which has become greatly congested.

Trenton Has Until Aug. 1, 1925, To Build Sewage-Works

The New Jersey Court of Chancery has so modified its injunction requiring the City of Trenton to stop polluting the Delaware River with sewage as to give the city until July 31, 1924, to submit plans for sewage-works and until Aug. 1, 1925, to build the works. This is a sequel to the action of the State Board of Health, on July 31, rejecting for the second time and finally plans for the direct-oxidation process and giving the city a year to file plans for treating the sewage by sedimentation. (See *Engineering News-Record*, Aug. 2, p. 198).

Rock Fill Dam for Hydro-Electric Plant in Kentucky

A rock-fill dam 800 ft. long and 270 ft. high above river bottom will be the principal engineering feature of the plant for 30,000 hp. hydro-electric development now being built on the Dix River near Lexington, Ky., by the Kentucky Hydro Electric Co., which is backed by the Middle West Utilities Co., Chicago. The head will be 235 ft. from river bed to crest of spillway section. Concrete facing will be applied to the rock fill and this in turn will be faced with timber. The dam is about 2¼ miles above the mouth of the Dix River, which discharges into the Kentucky River. At present the site is being cleared, railroad spur constructed and camp buildings erected, while construction equipment is being forwarded. L. F. Harza, Chicago, is designing engineer, and the L. E. Myers Co., Chicago, has the construction contract.

Work on Parkway Tunnel in Philadelphia to Resume

The Commissioners of Fairmount Park, Philadelphia, are making plans for resumption of work on the tunnel that will carry surface cars under the Parkway in front of the Philadelphia Art Museum, work on which was stopped several months ago when funds provided for the purpose were exhausted. Resumption is made possible by the transference of about $180,000 from the Department of Public Works to the Commissioners of Fairmount Park.

The tunnel on which work is to be started is at present simply an open cut extending across the Parkway. When completed this tunnel will carry surface cars from Spring Garden Street under the Parkway to the Spring Garden Street bridge over the Schuylkill River.

The sum set aside is not sufficient to complete the entire tunnel and put it in operation, but it will permit completion of the portion of tunnel directly crossing the Parkway, and the extension of the Parkway over this portion of the tunnel.

Irrigation District Votes $23,000,000 Bond Issue

Verde River Project Contemplates Storage of 1,200,000 Acre-Ft. and Developing 68,000 Hp.

Special Correspondence

With but a single adverse ballot voters of the Verde River Irrigation and Power District on Aug. 7 approved the issuance of $23,000,000 in bonds for constructing a dual irrigation and hydro-electric project, plans contemplating the storage of 1,200,000 acre-ft. of water in two reservoirs and the development of 68,000 hp. in seven power plants. The district, which will operate under the laws of Arizona, at present comprises dam sites, power sites, canal rights-of-way and 102,000 acres of irrigable land adjacent to and north of the Salt River Valley Water Users' Association—the Roosevelt project near Phoenix. The district has a right to the flood waters of the Verde River, and the amount of the normal flow not diverted by the Salt River Valley Water Users' Association. Pursuant to the action of the voters of the Verde River district bonds will be advertised for sale in the near future and construction work will be started as soon as the bonds are sold.

Power to Carry Financing

To pay off the bonds from straight irrigation assessments would create a comparatively heavy annual bond charge for a large part of the thirty-year bond issue. In order to make the project more feasible from a financial standpoint, it is necessary to develop hydro-electric power in connection with the irrigation plans, making a dual purpose project. The two reservoirs make it possible to develop about 200,000,000 kw.-hr. per year primary power, and there is also about 20,000 additional kw.-hr. per year secondary power that can be developed by the above plants. There is sufficient market within 100 miles for all of the power and the gross revenue is estimated at $1,900,000.

The irrigation works include the construction of either a rock-fill or a concrete constant-radius arch storage dam with a maximum height above stream bed of 265 ft. and a capacity of 950,000 acre-ft.; a multiple-arch dam with a maximum height of 160 ft. and a capacity of 240,000 acre-ft.; a concrete arch diversion dam with a height of 28 ft.; canals of a total length of 62 miles; a small earth-fill dam; a distribution system for 102,000 acres.

Power will be developed in seven plants, according to the following distribution: 24,000 hp. operating under maximum head of 265 ft.; 3,700 hp. with maximum head of 90 ft.; 12,000 hp. with head of 292 ft.; 8,000 hp. with head of 190 ft.; 6,800 hp. with head of 145 ft.; 8,700 hp. with head of 175 ft.; and 4,900 hp. with head of 95 ft.

The directors of the district are E. W. Michael, president, and J. D. Bowers and H. C. Ludden. John G. Bailhache is chief engineer for the district.

Bluff Plan for Arkansas River Control Approved

District Judge Park Finds Official Project for Flood Control at Pueblo Most Adequate

Formal approval has been given the bluff plan for controlling the flood waters of the Arkansas River at Pueblo, Colo., by District Judge Park, after hearings that lasted more than a week and after careful consideration of all controversial points and the examination of four other plans designed to avert repetition of the disastrous flood of 1921. In accordance with the court's decision construction work will start as soon as sale of the conservancy district bonds can be arranged. (For full description of the bluff plan see *Engineering News-Record*, July 12, p. 48.)

Three Objections Made

Three principal objections had been raised to the execution of the bluff plan; that it offered excessive protection; that it entailed expense out of proportion to the ability of the city and district to pay; and that it endangered the intake and distribution system of the South Side Water Board.

To the first of these objections Judge Park asserted that, though provision for the control of 115,000 sec.-ft. (25,000 sec.-ft. more than the peak flow during the 1921 flood) might be sufficient protection, he believed that the greatest reasonable protection, even though considered popularly excessive, should be provided. The bluff plan contemplates control of a flood of 180,000 sec.-ft., not an impossible flow as testified to at the hearing by flood-protection consultants.

On the proposition of expense Judge Park said that by far the greatest number of objections of increased taxation because of the improvement had been registered by property owners outside of the conservation district. An appraisal of cost given was that the bluff plan would increase taxes but $3.84 per $1,000 of valuation outside the district as against $2 per $1,000 valuation for the cheapest of the other four plans submitted. As $4,000,000 had been made as a high estimate and as a liberal sum was included therein for engineering, contingencies and the acquisition of property over which the new channel would flow, the actual construction could be done, it was estimated, at considerably under $3,000,000, a sum deemed not excessive by the court.

Water-Board Issue

Judge Park said that the objections of the South Side Water Board that its intake would be endangered could be raised against any of the plans and therefore was not to be taken as a too serious objection. That matter was something to be adjusted between the district commission and the water board, said Judge Park.

Opposition to the two other chief plans for controlling the Arkansas was registered by Judge Park principally on the ground that were greater floods to occur than 115,000 sec.-ft., Pueblo would have no protection.

Preliminary investigations and surveys for the project were begun in September, 1921, by the Dayton Morgan Engineering Co.

Moffat Tunnel Bid Opening Postponed Three Weeks

In order that contractors may have more time in which to study plans and specifications, bids for the construction of the Moffat Tunnel through the Colorado Rockies are not to be opened until Sept. 16 according to an announcement by W. P. Robinson, chairman of the commission. The original date was set for Aug. 25.

Southern Pacific to Build Natron Cutoff

Following the announcement that the United States Government will not appeal the recent decision against it in the suit for the dissolution of the merged Southern Pacific and the Union Pacific, the chairman of the executive committee of the Southern Pacific has announced that the railroad company will proceed at once to complete the Natron cutoff. Work on the cutoff was stopped in 1912 when the dissolution suit was started. There still remain 118 miles to be constructed, from Oak Ridge, Ore., over the Cascade Mountains to Kirk, Ore. Survey parties are now at work on this line, which will not only open up a fertile section of country but will also give the Southern Pacific a second line parallel to the coast with much better grades than there are on its present line. The total cost of the work will be between $10,000,000 and $12,000,000.

Illinois Society Acts in Case of A. P. Davis

After consideration of the recent dismissal of A. P. Davis as Director of the U. S. Reclamation Service, the Illinois Society of Engineers has passed the following resolutions:

"Resolved, That in regard to the recent summary dismissal of A. P. Davis, a highly competent and experienced engineer and executive, from the position of Director of the U. S. Reclamation Service, the Illinois Society of Engineers makes emphatic protest against this action of the Secretary of the Interior and against the unjust and sinister method in which this dismissal was effected, namely, by abolishing the position, thus leaving the Director without opportunity for redress.

"Furthermore, protest is made against the appointment of a local banker to practically the same position, but under another title created for the purpose.

"Resolved, That the position in question is one requiring both technical skill and administrative ability, both of which have been exercised by Mr. Davis for several years with marked benefit to the Reclamation Service, the public, and the development of the arid region. And such political interference with work of such importance is a serious detriment to the public welfare, to the work of the Reclamation Service and to the civil service principle, as well as to the engineering profession!"

California A. G. C. Protests Bidding Up Wages

At a special meeting of the Executive Board called for the purpose of dealing with the objectionable practice of contractors bidding up wages for building craftsmen during periods of apparent shortage of help, the Southern California Chapter of the Associated General Contractors of America adopted a resolution against this practice. This resolution, which has been sent to employers in the building construction industry, calls upon the builders and contractors of Southern California to put an immediate end to the practice of recruiting crews of skilled workers from other jobs by offering to pay more than the prevailing wages. The resolution calls attention to the hardship caused to the builders so deprived and the restriction of output of local workmen because of lost time in turnover and the removal of incentive for honest effort.

Break in 24-in. Water Main at Seattle, Wash.

PAVEMENT BROKEN BY BURST WATER MAIN AT SEATTLE

A break in a low-service water main at Seattle, Wash., July 20, broke up pavement, as shown in the accompanying view, flooded basements and damaged property to the estimated amount of $50,000. Gates only a block distant in either direction made the stoppage of the flooding easy.

Sacramento Municipal Utility District Created

By a popular vote of 6,378 to 978 out of a total registration of about 36,000 a municipal water and power development scheme for the benefit of Sacramento, Calif., and presumably some adjoining territory, was authorized on July 2. The proposal voted on was the creation of the Sacramento Municipal Utility District, and the election of five directors of the district. The project on which engineers have already made a preliminary report is for the development of a maximum of 150,000 hp. from the waters of Silver Creek, a tributary of the American River, together with the purchase of the distribution systems of the Great Western Power Co. and the Pacific Gas & Electric Co. within the newly created district. Condemnation proceedings for acquiring these distribution systems are proposed. The estimated cost of the entire project is $8,000,000, divided equally between the new power development project and the acquisition of the distribution system named. An election to vote on bonds for the project is proposed for this fall.

The storage system includes two main reservoirs with a total ultimate impounding capacity of 210,000 acre-ft. and a tributary drainage area of 191 sq.mi. One of the two main reservoirs would be at Union Valley on the main fork of Silver Creek and would be formed by a dam 302 ft. high. The other main reservoir would be at Ice House on the south fork of Silver Creek and would be formed by a dam 138 ft. high. H. C. Bottorff is city manager of Sacramento.

F. A. E. S. Active in Pushing Coal Storage Investigation

Pursuant to its investigation into storage of coal, in co-operation with that of the United States Coal Commission, the Federated American Engineering Societies has sent out a questionnaire to local storage of coal committees of the various engineering organizations, and to their sub-committees, to be by them distributed to the industries.

Printed outlines and sheets giving classifications of industries to be covered are being sent to the chairmen of local storage of coal committees. Upon receipt of these, the chairmen are requested to call meetings of their committees, select the most important consumers of coal in their city and its vicinity, then distribute the questionnaire to the official of each company who will be best able to supply the information desired. Request is made that the classification of industries be followed and that as many companies as possible under each classification be covered, but at least one under each group.

The local committees are at liberty to develop plans as extensively as possible, securing the co-operation of local civic organizations, trade associations or individuals. The Storage of Coal Committee of the F. A. E. S. will handle from the executive office in Washington the largest corporations which have affiliations and branches in many cities, especially the steam railways, steel mills, meat packing houses, sugar refineries, dock and pier storage companies and the navy and merchant marine.

Developing More Water Power in Minnesota

To meet the rapidly increasing power demands of the Mesabi and Vermillion coal ranges of Minnesota a number of electric developments are under way. The Phoenix Utility Co. is increasing its capacity by 40,000 hp. at an estimated expenditure of $7,000,000. The Kawishiwi hydro-electric development of the Minnesota Utilities at Ely, Minn., is nearing completion. It will have an output of 12,000 hp. which will be transmitted 52 miles to the iron mines at Virginia at a voltage of 110,000. The Great Northern Power Co. is also constructing a 110,000-v. line from its Thompson plant to the western end of the Mesabi range. In addition to these developments a 30,000-hp. hydro-electric plant has been started on the St. Louis River just above Fond-du-lac, Minn. This project involves the construction of a concrete dam 100 ft. high and 650 ft. long. Eighteen-foot penstocks will serve the two 15,000-hp. generators.

Cannot Zone Against Two-Family Houses in New Jersey

Direct prohibition of two-family houses is not permissible under the New Jersey statute authorizing municipalities to enact zoning ordinances, declares Chief Justice Gummere in a Supreme Court decision filed on July 31. The suit was brought by the owner of a three-story brick building in Westfield, who had been denied a certificate of occupancy for two families. The judge held that zoning ordinances in New Jersey are based on the promotion of the public health, safety and welfare, and that:

"The [Westfield] ordinance operates upon every residence within the prescribed district, without regard to its size, sanitary appliances or convenience. It permits occupancy and use of a residence by a single family, no matter how large, but prohibits occupancy by two families, although the total membership of the two may be much less than that of the one.

"In short, its only purpose, so far as can be discovered from the language used, is to place a restriction upon the use of residential properties within the designated area without any pretense that such restriction is reasonably necessary for the public health and safety."

High Speed Motorway for Britain

An innovation in British highway improvement schemes is the proposal to construct a high-speed road from London to Birmingham, about 100 miles. This project will be taken in hand by private enterprise, with the approval of the Ministry of Transport. The route is through Aylesbury, Banbury, Leamington and Coventry. The road will be surfaced with concrete and will be 50 ft. wide and is estimated to cost about six-and-a-half millions sterling, including land, buildings and bridges.

Only mechanically-propelled vehicles will be permitted and pedestrians will be prohibited. Each vehicle will be subject to a toll on tonnage, from which the revenue will be derived. It is estimated that a saving of 20 to 35 per cent on transport charges will be effected. Public passenger cars will run at scheduled times at speeds of 30 to 50 m.p.h. stopping only at the main towns. If the project is a success the road will be extended to Manchester.

Wateree River and Swamp Crossing Is Completed

On July 22 the completion of the Wateree River bridge, on the main highway between Columbia and Sumter, S. C., was celebrated by a large opening ceremony held at Statesburg. The bridge, 4¾ miles long with its approaches through the swamps of the Wateree, is one of a group of four large river crossings now under construction in South Carolina to provide intercommunication in the coastal plain section of the state, as outlined by J. L. Parker, bridge engineer of the state highway department, in *Engineering News-Record* of Nov. 3, 1921, p. 725. Hitherto the main rivers of the state have not been crossed by a bridge within 170 miles of the sea, and ferries have been the only means of communication; the program now in course of execution is the beginning of the work of correcting this condition.

RIVER CROSSING AND CONCRETE TRESTLE OF WATEREE BRIDGE

The Wateree bridge with approaches cost about $300,000, of which half was expended on the main structure. This is slightly over 2,000 ft. long, and comprises two 168-ft. steel spans, 25 spans of concrete trestle of 36½ ft. each, and 49 spans of creosoted timber trestle of 16 ft. each. It was built by the Hardaway Construction Co., of Columbus, Ga., and the Austin Bros. Bridge Co., of Atlanta, Ga.

Random Lines

How To Become a Consulting Engineer

Sir:—You and your lynx-eyed correspondents have uncovered some decidedly rare specimens of specialized engineers. A much older member of this family is the self-styled "Consulting Engineer" of a certain type. How they "get that way" has long been a source of wonderment to the writer.

Perhaps the answer, in part, at least, may be found in the enclosed advertisement which was clipped from the Help Wanted columns of the Aug. 8 issue of the New York *Times*.

> ELECTRICAL ENGINEER, who has had considerable experience in transformer design to tutor an engineer about to engage in consulting work in the fundamentals and practical design; evenings preferred; state experience, location and rate. C 400 Times.

The advertiser, an embryonic "Consulting Engineer," in this instance, at least, is apparently endeavoring to become prepared in the fundamentals of his chosen field before he essays to advise the rest of the profession. Let that much be recorded to his credit. For it is much more than can be said of quite a few of his brethren.

A. E. C.

* * *

Up in Buffalo, Karr Parker has been elected president of the local engineering society. Under the inspiration of such a name the Buffalo society should get something done about the automobile congestion in the downtown district.

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In Explanation

A correspondent has submitted an advertisement of a "belting engineer" to be added to our *index ridiculosus* of adjectival engineers. This prompts a brief explanation. There are many adjectives quite properly applied to the word engineer to describe a specialty. The test of propriety would seem to be the qualification of the person so described to the term engineer, unmodified and alone, and the justification of the specialty to be a branch of engineering. Thus our much advertised friends the "exterminating engineers" are jokes, because the gentlemen who engage in this useful business are not, when so engaged, engineers, nor is the removal of bugs from kitchens a branch of engineering. So too our "hymn book engineers" and a newcomer, a "kitchen engineer" who helps a Buffalo supply house sell cook stoves and steam tables, are only stealing an honorable title. On the other hand when you come to "belting engineers" the case is not so clear. The proper solution of the problems of belt design and application may call for engineering skill and there may reasonably be engineers whose entire professional practice is confined to so narrow a field. There may be criticism for such close delimiting of professional activities, but it is all in the family. The jibes at "insurance engineers," who are merely insurance salesmen and "merchant engineers" who are heaven knows what, are expressions of group resentment. The more publicity that can be given to such resentment the sooner will the practice of title stealing be stopped.

Six Scalded to Death When Bus Rams Concrete Mixer

Six women died from burns and shock received last week when the autobus in which they were returning to New York City from an outing rammed a concrete mixer, near Nyack, ripping away the main steam supply line from the boiler to the mixer. The accident happened on Highland Avenue, where a state road is under reconstruction. The road is being rebuilt half width at a time. Two buses composed the party; and the first of these had succeeded in passing the mixer on the narrow strip, but the second sideswiped it, then became so entangled in the wreckage that the bus driver was unable to proceed. The broken steam line enveloped the occupants of the bus, who were all employees of the *Christian Herald*, New York City, with steam, with the fatal results noted.

Though the accident happened in the evening after the road gang had quit for the day, it is said that the mixer boiler showed a steam pressure of 150 lb. When the line was broken, the mixer tender could do nothing to shut the steam off. The road at the point of the accident is being reconstructed under state supervision.

An investigation is under way to determine the exact cause of accident and to fix responsibility for its fatal results.

New Hudson River Connecting R.R. Will Have No Grade Crossings

In anticipation of any future need of grade crossing separation, the Hudson River Connecting R.R. Co., which is building the Castleton cut-off on the New York Central System, will provide over or under crossing for all of the seventeen highways on its new line. For this purpose it has presented five petitions to the Public Service Commission at Albany. Physical conditions determine the type of crossing used at the various points. The plans filed call for an overhead bridge at Courtney crossing in Stuyvesant, an under pass at McCabe's in Stuyvesant, and under passes for the Requas highway and the county highway in Columbia County. The two latter highways are to be reconstructed by the railroad on a new alignment.

City-Manager Plan Voted Down at Plainfield, N. J.

The commission-manager plan of city government has been rejected by the voters of Plainfield, N. J., 2,225 to 346. The total vote was only 40 per cent of that at the last gubernatorial election and the vote for the plan was less than half the number of signers of the petition. The election was held under a law passed last winter—the first authorization of the manager plan in New Jersey. The plan was also defeated recently by the voters of Deal, the first municipality in New Jersey to vote on it. Plainfield is operating under the mayor-and-council plan, and is one of a few cities or towns of size in the state which has not adopted the commission as contrasted with a commission-manager plan.

Coolidge Withholds Policy on Anthracite Question

While officially there has been no move made by the federal government in the anthracite situation, it is known that the threatened cessation of work in the hard coal fields when the present agreement expires Aug. 31 has been given considerable thought by President Coolidge as well as by other officials. Despite many rumors and newspaper reports asserting as a fact that first one course then another will be pursued by the government there has been no formal announcement of policy.

The activities of the Coal Commission have been restricted in the last week owing to the halting of governmental activities in Washington for three and a half days on account of the death of President Harding. Members of the commission have been watching for developments in the anthracite situation but formal meetings of the body practically were suspended for a week.

The Coal Commission made public last Wednesday a report submitted it by a special staff composed of Henry S. Dennison, Willard E. Hotchkiss and Joseph H. Willits, on "Labor Relations in the Anthracite Industry." This report was one of those upon which the commission based its recent report and recommendations regarding the anthracite industry.

The commission also made public a statement showing that it will be impossible for the commission to make the detailed investigation of the retail coal industry throughout the country as such a survey would cost $2,000,000 and in all probability would not be conclusive.

As the crisis in the anthracite industry through the apparent deadlock in negotiations between operators and miners is of immediate importance and is pressing for attention as the days of August pass, the situation has been called to the attention of President Coolidge by a number of visitors who were accorded audience with him in his first week as Chief Executive. It may be stated upon reliable authority that President Coolidge has not indicated a course of action definitely.

Newfoundland to Develop Power and Build Paper Plant

The Newfoundland legislature, on July 11, approved the agreement whereby the government will take over the Newfoundland Railway from the Reid-Newfoundland Co., along with land and port facilities belonging to that company. It also confirmed the agreement whereby the Newfoundland Power & Paper Co. is to develop hydroelectric power and establish a paper mill on the Humber River.

The company is to issue $20,000,000 worth of bonds, one-half of which is to be guaranteed by the British government, to be expended in Great Britain for machinery and other equipment; the other half is to be spent in acquisition of lands and buildings in Newfoundland.

The contract for the excavation of the canal on the Humber River, as the first step in this development, has been awarded to the Northern Construction Co. of Vancouver, B. C.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The North Carolina Society of Engineers held its annual convention August 10 and 11 at Asheville, N. C., and the North Carolina Branch of the American Association of Engineers held its sessions at the same time. John L. Becton is president and H. K. Witherspoon is secretary-treasurer of the first-named society.

The New York Chapter of the American Association of Engineers has elected the following officers: E. G. Haines, president; Dr. D. B. Steinman and Walter E. Brown, vice-presidents; Paul S. L. Bolger, treasurer, and Walter A. Craft, secretary.

The Duluth Engineers Club recently elected Frank Hutchinson president for the coming year. A. U. Shipman is the retiring president. Other officers elected are: Arthur M. Frazee, first vice-president; H. W. Richardson, secretary; Fred C. Baluss, treasurer; and F. E. House, J. L. Pickles, W. A. Clark and A. U. Shipman, directors.

Personal Notes

J. M. MARSHALL has been appointed district engineer of the Portland Cement Association office at Atlanta, Ga., succeeding WALTER B. ELCOCK, who has recently been promoted to assistant general manager in charge of the southeastern offices of the association. Mr. Marshall is a graduate of the Virginia Military Institute. To 1917 he was engaged in engineering work for the Seaboard Air Line and Pennsylvania R.R., and in rapid transit subway construction in New York City. He was a captain in the 11th Engineers and since the war has been connected with the New York office of the Portland Cement Association.

JAY T. WILLIAMS, civil engineer of Denver, Colo., and for the past seven years connected with the C. S. Lambie Construction Co., has been appointed building inspector for the city of Denver, succeeding FRANK M. LADD, retired by the newly elected mayor.

COMMANDER C. A. CARLSON, U. S. N., has been detached from duty as public works officer of the 14th Naval District at Pearl Harbor, Hawaii, and has been assigned to succeed CAPTAIN L. M. COX, U. S. N., the public works officer at Mare Island, Calif. Captain Cox has been on duty since 1919 and will be retired at his own request.

HARRY A. STORRS of San Francisco has been appointed chief engineer for the Modesto Irrigation District at Modesto, Calif., succeeding Percy F. Jones, resigned.

MYRON HENDEE, formerly connected with Thomas F. Bowe, consulting engineer, New York City, has taken up practice in surveying and municipal engineering in Bogota, N. J.

RUDOLPH P. MILLER, consulting engineer of New York City, the representative of American Engineering Council on the National Board for Jurisdictional Awards in the Building Industry, was elected chairman of that board at its recent meeting in Atlantic City, N. J.

STAFFORD X. COMBER announces resumption of private practice as consulting engineer in public works and general construction in the domestic and foreign fields. Mr. Comber, who is an American, educated at the University of London, was in 1918 retained by the British government to report on water resources in British Guiana, and also built reinforced-concrete drainage and irrigation works at Demerara. Later for a European contracting firm he visited the Mourne Mountains, Ireland, and reported on a large dam construction for the city of Belfast. Again for the British government he reported on a route for a mountain highway and hydro-electric railway to the interior of Venezuela and Brazil. Mr. Comber's earlier work was with contractors in New York City, on Pennsylvania R.R. tunnels, on work for the Ashokan Dam and the Catskill Aqueduct, on subway construction and underpinning of large city buildings. For a short time he was production superintendent of ten factories in France and Belgium breaking down surplus Allied and surrendered German ammunition and recovering metal and chemicals for commercial use; also he was for a time progress engineer for the Southern California Edison Co. His present address as consulting engineer is 32 West 40th St., New York City.

LOUIS E. AYRES, GEORGE E. LEWIS, ROBERT NORRIS AND DONALD C. MAY, Ann Arbor, Mich., announce the formation of a partnership for the practice of hydraulic and electrical engineering. All of these men have been with GARDNER S. WILLIAMS, consulting engineer; Mr. Ayres as principal assistant engineer, Mr. Lewis as electrical engineer, Mr. Norris as supervising engineer and Mr. May as designing engineer. Mr. Williams will continue his consulting practice at his old address.

W. EARL WELLER, city engineer of Binghamton, N. Y., has accepted a position in the Bureau of Municipal Research, Rochester, N. Y., to compile data on municipal projects in all sections of the country of interest to the city of Rochester. Mr. Weller designed the boulevard lighting systems of Binghamton, established a new accounting and tax assessment system for the city, and also designed the memorial bridge across the Chenango River. Mr. Weller has not definitely decided when he will leave Binghamton.

NORMAN L. STANN, chief engineer of the Department of Wharves, Docks and Ferries, Philadelphia, Pa., and for 27 years in municipal service in Philadelphia, having been made assistant engineer of the Bureau of Surveys in 1897, has retired, on the pension list.

JOSEPH A. ELLIOTT has been appointed superintendent for the Utah Construction Co. on the construction of a new line of the Southern Pacific in Mexico between Tepic and Guadalajara. Mr. Elliott has recently been in charge of the construction of an icing plant in Nevada for the Western Pacific Ry.

C. E. BLEE, formerly assistant engineer, California-Oregon Power Co., Medford, Ore., has accepted a position at Vaucouver, B. C., as chief assistant to E. E. Carpenter, consulting engineer in charge of new construction for the British Columbia Electric Co. Mr. Blee has been associated with Mr. Carpenter on three previous construction jobs, the Jordan River power development and the Sooke water project on Vancouver Island, and in the construction of buildings for the Panama-Pacific International Exposition.

IRVING R. FRAY has severed his connection with the Louisiana Highway Commission, engineering department, where he has served since the organization of the commission, and has been made special representative of the Southern Surety Co., of Des Moines, Ia., with headquarters at Baton Rouge, La.

Obituary

LEROY W. CUMMINGS, a highway engineer in the employ of the California Highway Commission, died near Clear Lake, Calif., recently at the age of 43 years. Mr. Cummings was a graduate of Harvard University. Prior to the World War he was a construction engineer for the California Highway Commission. He served during the war as a captain of the 23rd Engineers and then became senior highway engineer with the Bureau of Public Roads stationed at Chicago. Later he rejoined the military establishment as captain of engineers but resigned on account of poor health and in the spring of 1923 again entered the service of the California Highway Commission.

THEODORE RALL, chief engineer of the Strobel Steel Construction Co., died recently in Chicago. He was the inventor of the Rall type of bascule bridge.

HERMANN J. STROBEL, supervisor of appraisals, of Stone & Webster, Inc., Boston, died Aug. 3 following an operation. He was 41 years old and had been with the Stone & Webster organization for the past eleven years in electrical engineering and appraisal work. From 1905 to 1911 he was with the New York Central & Hudson River Railroad in New York as chief draftsman and assistant engineer on the electrical work of the Port Morris and Yonkers power stations and the Grand Central Terminal.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Steel Corporation Starts Abolition of 12-Hr. Day

Change to Eight Hours to Be Gradual—Workers to Get Higher Pay Rate But Will Earn Less

In accordance with a decision arrived at more than a week ago by the American Iron and Steel Institute, confirmation of which intent was given later by Judge Elbert H. Gary, abolition of the 12-hour day in the steel industry begins today, Aug. 16. This action is the culmination of a series of conferences which began late in June after President Harding had asked the Institute to guarantee ending the long steel day as soon as labor conditions in the industry would permit. Elimination of the 12-hour shift and the 24-hour shift once every two weeks will progress as rapidly as the supply of labor will permit. It will not, however, be simultaneous in all of the Corporation plants, changes depending upon labor conditions in the respective mills.

Judge Gary's Statement

According to Judge Gary's statement of ten days ago "where the hours of employees connected with continuous process are reduced from 12 to eight hours, their wage rates will be so adjusted as to afford earnings equivalent to a 25 per cent increase in hourly and base rates. All other workmen will be on 10 hours or less and their present hourly and base rates will be continued; but whenever it is practicable, by promotions or changes in position, the daily earnings will be accordingly adjusted."

It has been estimated that 60,000 more men will be needed in the steel mills to make possible the total elimination of the 12-hour day. It is understood that about 60 per cent of the quarter million employees of the Corporation are working on the two-shift basis of 12 hours each. The hourly rate of these workers is 40 cents. The daily wage would therefore be $4.80. Should the hour rate increase 25 per cent, that would mean a base pay of 50 cents, and on an eight-hour shift a daily rate of $4. In wages therefore 80 cents a day will be lost but four hours more leisure will be gained for the workers.

Effect on Prices

What effect the elimination of the 12-hour day will have on the price of steel products is problematical, but when a change to eight hours was first considered the Institute received a report from an investigating committee that prices would be raised about 15 per cent by the change. Installation of mechanical devices and removal of certain immigration restrictions to allow the absorption of a greater number of alien workers should, it was believed, offset this theoretical price advance.

Oil Equipment Manufacturers To Hold Exposition at Tulsa

With 125 manufacturers of oil equipment and appliances signed up as exhibitors at the International Petroleum Exposition and Congress, to be held in Tulsa, October 8-14, the directors of the "first world oil show" declare the display of machinery, scientific instruments, mechanical equipment and new devices, all of interest in some phase of the oil industry, will be one of the largest exhibitions held in that part of the country. Every phase of the oil business will have its technical display. Supply companies, belt and cordage makers, rig manufacturers, tank and pipe makers, will all present displays—for oil producers. Displays also will attract the refiner, the jobber, marketer and filling station man.

Tulsa's convention hall will be the center of activity during the exposition. Streets on all sides of this building will be closed and fair buildings are to be erected for housing the displays.

New July Record Set for Automobile Production

Production of motor vehicles in July was 318,000, according to the estimates based on shipping reports received by the National Automobile Chamber of Commerce. As expected, July showed a slight seasonal decline, compared with the extraordinarily large records of the previous months; but compared with the corresponding month in previous years July set a new record, gaining 29 per cent over July 1922. The weekly trend in production was upward during July, the last two weeks being larger than the first two weeks in the month. The output of cars and trucks during the first seven months of this year was 2,344,000, showing an increase of 68 per cent over the corresponding period last year.

Number of Locomotives Needing Heavy Repair Increases

According to a recent statement issued by the Car Service Division of the American Railway Association, Class One railroads of the United States had in need of repair on July 15, 11,855 locomotives, or 18.6 per cent of the total number on line. This was an increase of 405 over the total number on July 1, at which time there were 11,450. Of the total number on July 15 last 10,784, or 16.9 per cent, were in need of heavy repair. This was an increase of 458 over the number in need of such repair on July 1.

The railroads on July 15 had 2,437 locomotives in good repair and stored away to meet increased traffic demands later in the year. This was an increase of 256 over the number in storage on July 1.

During the first fifteen days in July 18,290 locomotives were repaired and turned out of the shops.

Preliminary Plans Made for 1924 Road Show

Record Convention and Greatest Number of Exhibitors Forecast — Questionnaire Circulated

From interest manifested by exhibitors and state highway officials, the 1924 convention of the American Road Builders' Association will be greater than any previous one, according to Charles Upham, convention manager and state highway engineer of North Carolina. Already preliminary plans for the convention and the Road Show have been made and certain blanket contracts entered into for moving machinery to the Coliseum in Chicago where the Show is to be held.

Mr. Upham, in a recent bulletin, asserts that the indications point to an early rush for space and that while every attempt will be made to locate satisfactorily all exhibitors, it is already apparent exhibitors will not be able to get as much space as they desire, nor will location in every instance be ideal. However, with the idea in mind to locate every exhibitor as agreeably as possible, a questionnaire has been circulated among manufacturers requesting information as to satisfaction of location and amount of space at the 1923 convention, value of registration of delegates to the convention, the comparative value from an exhibit standpoint of various exhibit locations.

Road Show Dates

The Road Show is to be held from January 14 to January 19. The Coliseum will be occupied until 12 o'clock on Jan. 12. However, exhibitors are to be allowed to store their equipment up to five days ahead of this time in the annex. Exhibits in the ballroom may be set up Jan. 7. The main floor of the Coliseum will not be available until Jan. 13 and the balcony until Monday, Jan. 14. This condition will exist because a show is to be held in the Coliseum during the week previous to the American Road Builders' Show. Negotiations are now under way with the Coliseum people to change the time of the show that is to be held previous to the Road Show, so that additional time may be secured. Definite arrangements on this score are to be concluded before Aug. 20. The Greer Building will be available to exhibitors five days previous to the opening of the Road Show.

The Congress Hotel has been selected as convention headquarters where the daily meetings and the annual banquet will be held. The organization for handling the Road Show in 1924 will be somewhat similar to that which functioned this last January.

Engines Exported

Exports of stationary internal combustion engines during May, according to figures from the Department of Commerce, were as follows: 359 Diesel and semi-Diesel engines valued at $130,976; 2,968 gas engines not over 8 hp. valued at $255,265; and 113 gas engines over 8 hp. valued at $72,251.

Argentina received the greatest number of the Diesel engines, 310, costing $117,800. Japan was the biggest user of the gas engines under 8 hp., taking 1,225, costing $100,220.

Government Figures on Industrial and Commercial Movements

The Department of Commerce announces the following figures representing industrial and commercial movements in june:

Contracts awarded for construction in 27 northeastern states amounted to $323,559,000 in June as against $374,400,000 in May and $343,440,000 in June a year ago. In point of floor space construction contracts awarded in June aggregated 46,344,000 sq.ft. as against 60,430,000 sq.ft. in May and 60,526,000 sq.ft. in June, 1922.

Production of Southern pine lumber amounted to 450,408,000 board feet as compared with 499,247,000 ft. in June a year ago. Stocks on hand at the end of June aggregated 1,054,133,000 ft. as compared with 1,095,580,000 ft. on June 30, 1922.

Production of oak flooring in June amounted to 34,342,000 board feet as against 34,636,000 ft. in May and 23,495,000 ft. in June a year ago. New orders booked called for 15,081,000 ft. as against 22,677,000 ft. in May and 24,472,000 ft. in June, 1922.

Production of clay fire brick in June amounted to 63,861,000 bricks as against 48,367,000 bricks a year ago. New orders amounted to 46,244,000 bricks as against 57,805,000 bricks ordered in June, 1922.

A total of 24,640,000 face brick was produced in June as compared with 26,057,000 in May and 28,673,000 in June a year ago. Unfilled orders at the end of June amounted to 54,128,000 bricks as against 57,363,000 bricks on May 31 and 43,283,000 on June 30, 1922.

Brick Paving Committee Conference Postponed

Due to the inability of two of its members to attend the meeting scheduled for Tuesday, Aug. 14, the session of the Advisory Committee of the National Paving Brick Manufacturers Association has been postponed until the following Tuesday, Aug. 21, at Cleveland. This meeting is primarily to consider and take action on the revised specifications and text book on Brick Pavements.

The invitation extended to the membership of the association to submit suggestions as well as to attend this meeting in person still holds good.

Steel Industries Plan Exposition

Over 100 manufacturers of steel mill apparatus have combined to hold an iron and steel exposition at the Buffalo, N. Y., auditorium, Sept. 24-28. Exposition managers plan to make the demonstration one of the greatest exhibitions of electrical, mechanical, power and combustion apparatus. One of the features of the exposition will be a modern electrified foundry which will be in actual operation under the supervision of E. T. Langworthy, a steel expert. The foundry will produce finished products and will start with hot metal, passing from machine to machine until its final form.

The purpose of the exposition is chiefly to bring to the attention of the steel mill world the latest improvements in devices which have to do with the conservation of fuel, production of steel, etc.

Gypsum Production for 1922 Nearly 4,000,000 Tons

According to a statement issued by the Department of the Interior, compiled from statistics collected by the U. S. Geological Survey, the demand for most of the gypsum products was greater in 1922 than in 1921. During the year 3,779,949 tons of gypsum were mined, an increase of 24 per cent over the output in 1921. The sales of agricultural gypsum decreased from 104,966 tons, valued at $490,902, in 1921, to 101,904 tons, valued at $387,203, in 1922. The sales of gypsum for use in Portland cement, paint, and other compounds amounted to 668,821 tons, valued at $2,056,143, an increase over the corresponding figure for 1921 of 24 per cent in quantity and of 16 per cent in value.

The accompanying table shows by uses the quantity and value of gypsum sold during 1922. Much of the difference between the 3,779,949 tons of gypsum mined and the 3,261,990 tons produced and sold in United States represents exports.

GYPSUM PRODUCED AND SOLD IN THE UNITED STATES IN 1922, BY USES

Calcined:	Short Tons	Value
Stucco	396,990	$2,813,561
Neat plaster	1,333,261	12,126,811
Sanded plaster	80,455	1,165,771
Mixed plaster	(a) 218,650	1,914,572
Plaster of Paris, molding, casting plaster, etc.	(b) 126,288	1,198,819
Keenes cement	21,991	324,316
Plaster board	42,088	945,171
Wall board	120,591	4,500,725
Partition tile	68,338	915,449
Roof tile	(c)	(c)
Special tile or blocks	44,834	368,068
Other purposes	37,779	644,542
	2,491,265	$26,917,805
Crude	770,725	2,443,346
		$29,361,151

(a) Includes small quantity of wood fiber plaster. (b) Includes dental plaster and plaster sold to plate-glass works. (c) Included under "Other purposes."

Compton to Study Lumber Conditions Abroad

Wilson Compton, secretary-manager of the National Lumber Manufacturers Association, is now in Europe and will represent the American lumber industry at the Swedish Tri-Centennial Exposition at Gothenberg. The Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce has requested A. X. Oxholm, chief of the lumber division, who is already in Europe, to accompany Mr. Compton on his special tour of the Swedish saw mills and forests. Mr. Compton's special purpose in the Swedish trip is to get a first hand impression of waste prevention and raw material utilization methods of Scandinavian mills.

The United States commercial attaches in different European cities will assist Mr. Compton in his study of the methods used in Europe for enforcing and guaranteeing lumber quality and dimension standards. Mr. Compton will also probably make a brief tour of German national and municipal forests, in company with a party of Oxford foresters under the guidance of Dr. C. A. Schenck, of Darmstadt, who was formerly in charge of the Biltmore Forest School in North Carolina.

West Coast Lumber Production 17 Per Cent Above Normal

One hundred and thirty mills reporting to the West Coast Lumbermen's Association for the week ending July 28, manufactured 103,264,839 ft. b.m. of lumber; sold 95,063,633 ft.; and shipped 97,842,724 ft. Production for reporting mills was 17 per cent above normal. New business was 8 per cent below production. Shipments were 3 per cent above new business.

Thirty-nine per cent of all new business taken during the week was for future water delivery. This amounted to 36,669,991 ft., of which 26,530,805 ft. was for domestic cargo delivery; and 10,139,186 ft. export. New business by rail amounted to 1,792 cars. Thirty-nine per cent of the week's lumber shipments moved by water.

In the first thirty weeks of the year, production reported to the West Coast Lumbermen's Association has been 2,941,715,476 ft.; new business 3,027,109,400 ft.; and shipments 3,210,996,676 ft.

Business Notes

RAYMOND CONCRETE PILE CO. announces the opening of a Pacific Coast office in the Washington Bldg., Los Angeles, Calif., with O. C. Struthers, formerly with Pratt & Thompson, Kansas City, in charge.

JOHNSON GAS APPLIANCE CO., Cedar Rapids, Iowa, manufacturers of gas torches and furnaces and other appliances, have taken over the manufacture and sale of the Moore self-cleaning rake, having acquired on July 1 all equipment, stock, patent rights, etc., of the Moore Self-Cleaning Rake Co. of Cedar Rapids.

SOUTHERN PINE ASSOCIATION at a recent meeting in Chicago elected H. C. Berckes, of New Orleans, secretary-manager to succeed the late J. E. Rhodes, who died recently. Mr. Berckes has been connected with the Southern Pine Association staff almost since its organization in 1915 and has been assistant secretary since 1919.

GILMORE OIL CO., Los Angeles, is the name of the new organization formed by the consolidation of the A. F. Gilmore and Gilmore Petroleum companies. L. Hoffman-Pinther has been named advertising manager.

FRANKLIN S. TERRY, co-manager of the National Lamp Works, Nela Park, Cleveland, was elected vice-president, and B. G. Tremaine, also co-manager of the National Lamp Works, was elected a director of the General Electric Co., Schnectady, N. Y., at a meeting of the board of directors held in New York City, June 22.

WHITING CORP., Harvey, Ill., has opened a district sales office in Birmingham, Ala., in charge of W. R. Hans as district manager. The Birmingham office will handle sales in Alabama, Georgia, Tennessee and northern Mississippi for the Whiting Corp, and its

subsidiaries, Grindle Fuel Equipment Co. and Swenson Evaporator Co. The Company also plans to open on July 1 a district sales office in Cleveland, Ohio, in charge of R. P. Dryer.

Equipment and Materials

Rugged Construction a Feature of 21-E Paving Mixer

Ruggedness resulting from the use of oversize shafting and other parts so as to prevent operating delays due to breakdowns is featured by the Ransome Concrete Machinery Co., Dunellen, N. J., in its latest model of 21-E paving mixer.

In this mixer all turned shafting is of 0.3-0.4 high carbon steel with diameters of 5⅝ in. for the traction shaft that drives the crawlers, 4⅞ in. for the traction speed change shaft, 4¾ in. for the traction reverse shaft, 3⅞ in. for the mixer drum drive shaft, 4⅞ in. for the drive shaft for the crawler treads, and 3⅝ in. for both the power loader winding drum and the boom bucket winding drum shaft.

The power equipment consists of a 40-hp. four-cylinder Hercules gasoline engine, which, it is claimed, may be stalled without bending the shafts or breaking the sprockets and gears. Heretofore, the company points out, steam power of 15 to 20 hp. has been used extensively for driving paving mixers.

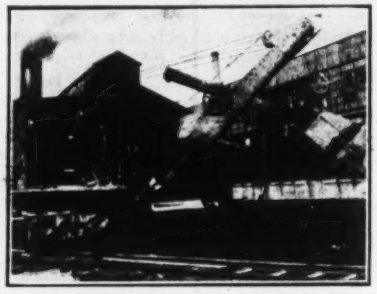
Many of the breakages as well as delays to paving mixers have been caused, it is said, by trying to transmit 40 hp. from a gasoline engine through shafts and gears designed for only 20-hp. steam engine operation.

The main frame consists of longitudinal members and has a three-point suspension on the axles to avoid undue strains during traveling over rough roads. The mounting is of the crawler type.

The loading hopper is constructed of ⅜-in. steel plate and is served by a power operated derrick with a reach of 14 ft. from the center of the paver to the center of the industrial tracks alongside for handling batch boxes. Delivery of the mixed concrete is by means of a 20-ft. boom and a bucket of 30 cu.ft. capacity of the bottom-dump spreading type. Overall dimensions of the mixer, including loader, are: Length, 20 ft. 9 in.; height, 3 ft. 11 in.; width, 10 ft. 1 in. The weight is 33,250 lb.

Crane Convertible to Shovel

A crawler-mounted locomotive crane, convertible to a ¾-yd. revolving shovel, is one of the new products of the McMyler-Interstate Co., Bedford, Ohio. The crane is steam operated and is fitted with the necessary mechanism for hoisting on either of the two main drums, operating a two-line bucket, lowering or raising the boom, rotating the crane and traveling. The machine

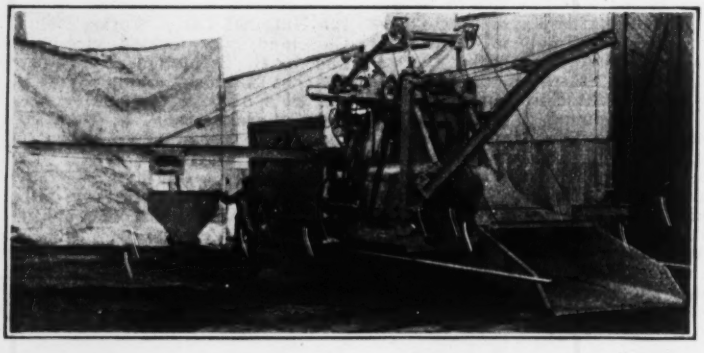


may be equipped with a boom 30, 35, or 40 ft. long, and its overall dimensions are length 16 ft. 7 in., width 8 ft. 10 in., and height 13 ft. 2 in. The operating weight of the crane is 55,000 lb. The crane has a capacity of 20,000 lb. at 12 ft. radius. A feature of the design is the accessibility of all parts for adjustment and repair.

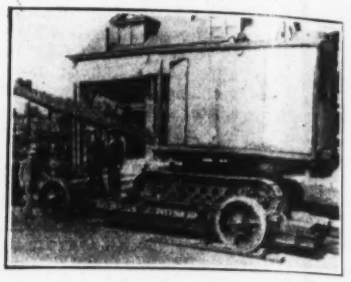
The various operations of the crane are actuated by a 6 x 8-in. double-cylinder, non-reversing engine. Link motions and reversing valves are eliminated through the use of right- and left-hand clutches for raising and lowering the boom, for slewing, and for propelling. For operation of the steam shovel the equipment includes a 17 ft. 6-in. boom and a 12 ft. 6-in. dipper handle.

Rubber-Tired Trailer Built for Transport of Heavy Equipment

For the quick transportation from one job to another of heavy construction equipment such as steam shovels, cranes, road rollers and concrete mixers, the Douglas Transfer Co., hauling contractor of Pittsburgh, is using a four-wheeled truck trailer with solid rubber tires having a carrying capacity of 50 tons, made by Rogers Bros. Co., Albion, Pa. The overall length of the trailer, from the end of the drawbar to the rear of the deck, is 26½ ft., the overall width 13½ ft., and the height from pavement to the top of the platform 22 in. The frame is composed of 8-in. steel H-sections and heavy 8-in. ship channels. The solid rubber tires are 14x40 in.



The Douglas company cites the following two instances of the performance of its trailer: A ¾-yd. Erie steam shovel was moved a distance of 11 miles over hilly roads in 3½ hr. actual hauling time. It was necessary to load and unload the shovel three times dur-



ing this trip on account of overhead obstructions of bridges, steam pipes and wires. Another trip of 12 miles over steep grades and under unfavorable weather conditions delivered a 20-B Bucyrus shovel in 5 hr. and 30 min. actual hauling time.

Publications from the Construction Industry

Gasoline Engines—STOVER MANUFACTURING & ENGINE CO., Freeport, Ill., describes in a 24-p. illustrated catalog its line of gasoline and oil engines from 1 to 30 hp. Most of the models shown are stationary types. One of the units is a 1½-hp. engine direct connected to a Myers pump and several of the outfits from 1½ to 12 hp. are mounted on four-wheel trucks, including one portable wood-sawing rig.

Truck Motors—GEORGE HAISS MANUFACTURING CO., INC., New York, has issued a 27-p. catalog, illustrated, featuring its path-digging truck loader for handling crushed stone, sand, gravel, coal and other loose materials. The loader is of the continuous bucket type mounted on crawlers. One of the machines illustrated is equipped with a measuring hopper at the discharge end. Several pages are devoted to a presentation of figures on loading capacities and costs as compared with hand shoveling.

Paint—E. I. DU PONT DE NEMOURS & CO., INC., Philadelphia, has just published a 200-p. illustrated book entitled "Principles and Practice of Upkeep Painting," written to serve as a practical aid to plant superintendents or others responsible for the maintenance of industrial property and equipment and as a help to architects and engineers in the protection of new construction. It covers modern painting practice for all types of exterior and interior surfaces. The data are presented in 28 chapters, taking up such subjects as the preparation of the surface for painting, methods of application, treatment of both wood, metal and cement concrete surfaces, light reflecting finishes for walls and ceiling. There is an important discussion of spray painting and suggestions on how to operate a paint shop and provide for periodical paint inspection. For every kind of use a specific type of paint is recommended. The book contains a supplement in the form of a color chart.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Public Bond Sales in July Far Below June Aggregate

The reaction from the exceptional activity displayed during June in the issuance of state and municipal bonds coupled with the customary dullness which comes at this season and the weakness of the security markets on the Stock Exchange, according to the monthly review in the *Commercial and Financial Chronicle*, New York, kept the aggregate of new municipal issues during July down to $59,107,271. This is $100,578,816 less than the June aggregate. The falling off was not confined to states and municipalities in this country but extended to Canadian municipal and Provincial bonds.

The largest issue during the month, $3,500,000 5½s., was sold by the Everglades Drainage District at a price reported to be 95. There were two issues for $2,000,000; one by the state of Michigan for highway improvement bonds, the other put out by Cook County Forest Preserve District, Illinois.

The number of municipalities emitting long term bonds and the number of separate issues during July 1923 were 333 and 478 respectively. This contrasts with 425 and 594 for June, 1923; and 591 and 752 for July, 1922.

Of the forty representative bond issues included in the tabulation on this page, none was sold at par, three sold below par, the balance above par. The yields ranged from 4.16 to 5.37, and the rate of interest from 4 to 5½ per cent.

National Lumber Trade Steady

Although the national lumber trade, as reflected by reports from 398 of the larger commercial mills of the country to the National Lumber Manufacturers' Association here, fell off slightly last week, new business was up to the average of May and above that of June and the first part of July. While production declined from the high levels of May and June it is still in excess of shipments and orders. The general lumber movement is larger than at this time last year. Unfilled orders of the West Coast Lumbermen's Association's mills increased 5,000,000 ft. and those of the Southern Pine Association decreased 4½ per cent, as compared with the preceding week.

For all the reporting mills shipments were 88 and new business 82 per cent of production last week; for the Southern Pine mills, the percentages were 95 and 82, respectively, and for the West Coast mills 93 and 91. Most of the reporting mills have a normal production figure for the week, and according to that their actual production was 105, shipments 96 and orders (new business) 90 per cent.

Car Service Division Reports Record Freight Loading

According to a report issued Aug. 13 by the Car Service Division of the American Railway Association, the railroads of the United States on July 31 had 76,453 surplus freight cars in good repair and immediately available for service if necessary despite the fact that during the week which ended on July 28, 1,041,044 cars were loaded with revenue freight, the largest number for any one week in the history of the country. When a record loading of 1,018,539 cars was established during the week of October 14, 1920, which record remained until this year, a car shortage of 69,517 cars was reported.

The total number of surplus freight cars on July 31 was a decrease of 3,257 compared with the number on July 22. Of the total number on July 31, 57,831 were box cars, a decrease of 3,388 in approximately a week; while there were 6,546 surplus coal cars in good repair, an increase of 1,379 within the same period. Surplus stock cars numbered 3,437, a decrease of 846 since July 22, while a decrease for the same period of 648 was reported in the number of surplus refrigerator cars which brought the total for that class of equipment to 7,615.

REPRESENTATIVE PUBLIC BOND SALES DURING JULY AND AUGUST, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Oregon	State Highway	1,000,000	4½	98.66	4.64	Aug. 1, 1923	1928–48	Stacy & Braun, Eldredge & Co. and others
Phillipine Islands	Irrigation and public works	2,000,000	4½	95.30	4.88	July 1, 1923	1952	Hallgarten & Co., White, Weld & Co., Blair & Co., Inc., and Chase Securities Corp.
County								
Broward, Fla.	School	60,000	5½	102.25	5.33	July 1, 1923	1938–53	Ft. Lauderdale State Bank, Lauderdale
Mahoning, Ohio	Sewer improvement	280,000	5	101.67	4.76	March 1, 1923	1925–38	Hayden, Miller & Co., Cleveland
Brown, Ohio	Public improvement	23,800	5½	101.19	5.23	July 1, 1923	1927–33	Breed, Elliott & Harrison, Cincinnati
Franklin, Ohio	Sewers	26,500	5	100.05	4.99	May 15, 1923	1925–33	Tucker, Robinson & Co., Toledo
Madison, Ind.	Orphans home	125,000	5	101.18	4.81	July 16, 1923	1924–36	Breed, Elliott & Harrison, Indianapolis
Montgomery, Ohio	Sewers	33,000	5½	103.40	5.03	July 1, 1923	1925–39	A. C. Allyn & Co., Chicago
Anderson, Texas	Roads	266,000	5	100.98	4.91	Apr. 10, 1923	1924–53	Taylor, Ewart & Co., Chicago and syndicate
Ashtabula, Ohio	Roads	139,000	5½	101.06	5.24	Apr. 1, 1923	1924–32	Seasongood & Mayer, Cincinnati
Cass, Mich.	Roads	49,500	5½	100.84	5.32	July 1, 1923	1925–33	Cass County Bank, Cassapolis
Princess Anne, Va.	Road and bridge	250,000	5½	104.09	5.19	July 15, 1923	1928–57	C. W. McNear & Co., Chicago
Rush, Ind.	Road	29,160	5	100.23	4.95	May 15, 1923	1924–33	Breed, Elliott & Harrison, Indianapolis
Township								
Burlington, Ohio	School	55,000	5½	101.51	5.32	June 15, 1923	1924–45	Ryan, Bowman & Co., Toledo
Municipality								
Haverhill, Mass.	Streets and sewers	210,000	4½	100.15	4.21	June 1, 1923	1924–33	Estabrook & Co., Boston
Lewiston, Me.	Armory	200,300	4½	101.32	4.34	July 15, 1923	1924–43	H. M. Payson & Co., Portland
Akron, Ohio	Street improvement	555,200	5	100.70	4.86	July 1, 1923	1924–47	Eldredge & Co., New York
Bellaire City, Ohio	Schools	80,000	5	100.25	4.98	July 23, 1923	1933–48	Breed, Elliott & Harrison, Toledo
Cohoes, New York	Local improvement	211,481	4½	100.53	4.42	May 1, 1923	1934–37	A. M. Lamport & Co., New York
Honea Path, S. C.	School building and repair	65,000	5	101.16	4.89	July 1, 1923	1928–43	Bank of Honea Path
North Hempstead, N. Y.	Schools	130,000	5	105.38	4.49	June 1, 1923	1938–47	Lehman Bros., New York
Pittsfield, Mass.	Water and sewers	61,000	4½	100.92	4.28	July 15, 1923	1924–36	Estabrook & Co., Boston
South River, N. J.	Electric light	65,000	5	100.94	4.86	July 1, 1923	1925–39	First National Bank, South River
Troy, N. Y.	Water works ext.	44,000	4½	100.40	4.20	Aug. 1, 1923	1924–43	Manufacturers National Bank, Troy
Atlantic City, N. J.	General improvement	1,617,000	4½	100.21	4.73	July 1, 1923	1925–58	Geo. B. Gibbons & Co., New York
Framingham, Mass.	Sewers	240,000	4½	100.85	4.17	July 1, 1923	1924–53	Harris, Forbes & Co., Boston
Garden City, N. Y.	Water and sewers	905,000	4½	100.59	4.45	July 1, 1923	1928–52	Stacy & Braun and Eldredge & Co., New York
Hightstown, N. J.	Water	88,500	4½	100.10	4.74	June 1, 1923	1932–48	Hightstown Trust Co., Hightstown
Lynn, Mass.	Water, street and sewer	415,500	4–4½	100.03	4.22	July 1, 1923	1924–33	Estabrook & Co., Boston
Mount Vernon, N. Y.	Roads and sewers	175,000	4½	101.09	4.34	June 1-July 1, 1923	1924–42	Sherwood & Merrifield, Inc., New York
Pittsfield, Mass.	Paving	80,000	4½	100.45	4.34	July 15, 1923	1924–28	R. L. Day & Co., Boston
San Bruno, Calif.	Water works improvement	100,000	5	100.01	4.99	July 1, 1923	1928–43	Blyth, Witter & Co. and the Bank of Italy
Waltham, Mass.	School and sewers	176,000	4½	100.66	4.17	July 1, 1923	1924–53	Arthur Perry & Co., Boston
Dayton, Ohio	Street improvement	225,000	5½	103.11	4.79	Aug. 1, 1923	1924–32	Austin, Grant & Ogilby
Denton, Texas	School	200,000	5	98.00	5.14	July 1, 1923	1924–63	Mercantile Trust Co., St. Louis
Easthampton, Mass.	School	120,000	4½	101.27	4.21	July 1, 1923	1924–33	Estabrook & Co., Boston
Lenoir, N. C.	Water	125,000	5½	101.77	5.37	July 1, 1923	1926–63	N. S. Hill & Co., Cincinnati
Malden, Mass.	School and paving	401,000	4½	100.68	4.16	June 15-July 15, 1923	1924–43	Harris, Forbes & Co., Boston
Mayfield, Ohio	School building	226,000	5½	102.38	5.29	April 1, 1923	1927–47	Richard, Parish & Lamson
Nashua, N. H.	Road and sewer	125,000	4½	100.17	4.17	Aug. 1, 1923	1924–38	E. H. Rollins & Sons, Boston
Newcomerstown, Ohio	School	125,000	5	102.72	4.72	Jan. 1, 1923	1924–48	Richards, Parish & Lamson, Cleveland

To Reduce Industrial Accidents

In order to reduce industrial accidents in New York State, formation of an educational council to co-operate with the state labor department has been decided upon. Educational campaigns are to be carried to public schools, high schools, night schools and various vocational and continuation schools. Exhibits will indicate accident causes and how they may be avoided.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 89 to 97, are the following:

Store building, Los Angeles, Calif., to MacDonald & Kahn, $1,000,000.

Store, office and hall building, Chicago, Ill., to McKeown Bros., 112 West Adams St., $1,250,000.

Sewage treatment works, Chicago, Ill., to J. Griffiths & Sons Co., 112 West Adams St., $5,602,636.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 89 to 97, are the following:

Wharves, Houston, Tex., for Houston Port District, $4,000,000.

Apartment-Hotel, Chicago, Ill., for G. G. and E. C. Anders, $1,000,000.

Sewage-treatment works, Chicago, for Sanitary District of Chicago, $5,602,636.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.00	3.80	3.20	3.45	2.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	33.2@42.2%	40%	47.43
Cast-iron pipe, 6 in. and over, ton	62.30	56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.90	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—58.00@60.00	40.00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	—20.00@22.00	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.....
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	1.05	—1.08	1.19	1.14	—1.08	1.25	—1.18	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

A Little Review of the Situation

The very real likelihood of an industrial depression did not dissolve into a mere possibility until the middle of July, when *Engineering News-Record's* Construction Barometer said: "When a number of red flags are displayed for a considerable period of time it is likely that the danger indicated will be avoided." This danger in the construction industry was a large-scale buyers' strike caused by high cost.

There was a buyers' strike in the larger centers, but the construction thus curtailed was proportionately small, and the actual volume (not mere money value) of construction in 1923 is well ahead of 1922.

Interest centers chiefly in construction cost as the critical element of the situation. Since October, 1922, it has risen until at the beginning of June it reached a point 121 per cent above 1913. It has maintained that level to date, and is 28 per cent above a year ago.

Construction cost is high because the country is oversold on building materials and the demand for labor is such as to encourage high wages. Last year's construction amounted to $4,500,000,000. Contracts awarded in the first half of 1923 reached three billions.

The only practical relief is in producers of construction materials catching up on their orders. Contract-letting declined 14 per cent in July, with indication of a further falling off in August. This is, of courser seasonal and should furnish the breathing space needed to fill present orders. The unfilled steel tonnage curve (see The Construction Barometer, July 26) indicates this catching-up process on the part of the United States Steel Corporation. That general business remains active is shown by heavy freight car loadings. Total loadings for the week ended July 21 was 1,028,927 cars, which is the heaviest in the history of railroading.